THE

ELECTRICAL REVIEW.

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	Page
The German Electrical Industry ...	909
Municipal Engineering Scholarships	910
The American N.E.L.A.	910
Electricity Works Table	910
Paupers' Palaces	911
Trade with Japan	911
The Electrification of the New York, New Haven, and Hartford Railway (*illus.*)	912
Present State of the Electrical Trade	913
Correspondence:—	
The Electrical Trade	914
The Wiring Cost of Small Houses	915
Proceedings of Institutions:—	
The Oxidation of Atmospheric Nitrogen	915
Underground Mains	916
The Use of Wooden Poles for Overhead Power Transmission (*illus.*)	917
Legal	921
Parliamentary	921
New Electrical Devices, Fittings, and Plant (*illus.*)	922
Business Notes	922
The Willans-Dick, Kerr Turbo-Generator (*illus.*)	927
Electric Tramways at Dumbarton (*illus.*)	929
The Bow Trolley	931
Notes	933
City Notes	935
Electric Tramway and Railway Traffic Returns	938
Stocks and Shares	938
Share List of Electrical Companies	939
Metal Market.—Fluctuations in May, 1907	941
Economical Testing of Generators and Motors (*illus.*)	941
Competition: A Suggestion	943
Paterson's Patent Fire-Resisting Cable	944
High-Pressure D.C. Transmission	944
The Present Tendency of Charging for Electricity (*illus.*)	945
Publicity: Or How I Bought a 5-H.P. Motor	947
New Patents Applied For, 1907	948
Published Specifications	948

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THE GERMAN ELECTRICAL INDUSTRY.

IN view of the depressed condition of business in this country, to which we have recently drawn attention, a certain amount of interest—melancholy interest, perhaps—will probably be manifested by British firms in the results of an inquiry which has just been undertaken in regard to the present condition of the German electrical industry. The matter is of some importance in view of reports, which are apparently more or less true, of a slight slackening in the iron and steel industry, and of a possible reaction in the electrical trades after a period of unexampled prosperity, which, to some extent, recalls the term preceding the collapse in 1900.

The inquiry, which represents a summary of the opinions obtained from the principal firms, shows perfect agreement in the statement that employment at present is still very satisfactory, and that the large firms have a considerable amount of orders in hand, whilst, in some cases, it is scarcely possible to adhere to the periods required for delivery. In considering the position, it is necessary to distinguish between the home and the foreign consumption. As far as the export market is concerned, the Customs conditions stand in the way of competition in the French and Austrian markets, particularly in the former, in so far as German industry has not freed itself to a certain extent by establishing independent undertakings in those countries. The export trade to Italy seems very favourable, that to Spain is also satisfactory, and South America is in part considered to be a large factor in the foreign business. But where the orders for German South American undertakings are not in some measure monopolised by special relations, complaints are made of severe competition by United States firms in the South American market, and this rivalry is also becoming noteworthily perceptible in other markets of the world. Taken altogether, the foreign business of the German electrical industry still offers really satisfactory prospects.

The foundation of the activity of the industry is, however, to be found in the inland requirements, which represent the barometer for the condition of trade, and in this connection the class of orders is of decisive importance. It is found that in the main the high degree of employment for the home market takes its origin from a time when the large German industries, particularly the iron and steel trades, had not recognised an impending weakening in the business situation. At that time the electrical industry was given enormous orders representing long-sighted engagements, as the firms placing the orders believed that, in view of the straining of the capacity of the electrical industry, it was necessary to make very early arrangements for their future needs. It is considered that many of those orders would no longer be given to-day, as the tendency largely manifests itself towards the limitation or avoidance of extensions of works. This tendency warns the electrical companies to exercise caution—

warns them to take into account a coming period of less brisk employment, and consequently to abstain, as far as possible, from an extension of their own establishments. The numerically enormous amount of turnover should not lead to an over-estimation, although gigantic figures are necessary to provide full and remunerative employment for the extensive works of the large firms.

The question of prices, which plays an important part in connection with the degree of employment, has also been considered within the scope of the inquiry. In the first place, it has to be remembered that a 20 per cent. increase for dynamos and other heavy plant has been introduced gradually since the autumn of 1906. It is stated that this advance is fully sufficient to meet the additional cost of raw materials, particularly copper. A reduction of the increase is not in contemplation at present, as the price of copper now stands higher than it was when the last augmentation in the charges for dynamos, &c., was made, the increase having been first 10 per cent., then to 15 per cent., and finally to 20 per cent. If the situation of prices on the basis set forth is satisfactory in general, there is unanimity of opinion that competition is very severe, notwithstanding the occasional arrangements and joint transactions between the large firms. This is especially the case in regard to business involving large sums, and in many cases the 20 per cent. increase is rendered illusory by extra rebates.

The labour question is also a matter of importance. There is no lack of workers in so far as Berlin is concerned, and that is practically the centre of the trade. A scarcity of labour is also not feared, and disputes with the workers are not expected. On the other hand, the condition of the money market still gives rise to apprehensions, especially in respect of the financing of new business by the banks. In conclusion, it is stated that the German electrical industry is arming itself for worse times. But it is not believed that the industry need fear more unfavourable periods, and in particular the possibility of a severe collapse is not even remotely believed in by the trade.

It is sincerely to be hoped that "worse times" will not be experienced in *this* country; surely we have plumbed the depths! But how can an improvement be effected? The first step in this direction is to trace the source of the trouble, the next to seek a remedy: and in the article on the present state of the electrical trade, which we print on another page, an attempt is made to accomplish this task, which we commend to the notice of our readers.

Municipal Engineering Scholarships.

Everyone has heard of the close-fisted municipalities which, in the language of their Committee minutes, regret to inform their consulting and borough electrical engineer and manager that they are unable to grant his application for an increase of salary to something in the neighbourhood of, say, £249 19s. 6½d. per annum, but in lieu thereof will be pleased to permit him to take one or two premium pupils (presumably if he can get them).

Again, how often the clause "the post carries with it the privilege of having two premium pupils," appears in some of the advertisements announcing vacant municipal appointments, as an additional attraction or set-off to the ofttimes anything but princely salary offered.

In Swansea quite a refreshing departure is made from the above-mentioned methods of procedure, for the Local Education Committee offers scholarships annually to pupils of the intermediate school and to students at the municipal technical college, covering free tuition at the college and articles of indenture to the borough electrical engineer or to the borough surveyor.

The Electrical Engineering Scholarship is tenable for three years, and is limited to the sons of ratepayers or those who have resided in the borough for at least two years. The candidates are selected by competitive examination and the recommendation of the Principal of the Technical College.

The first year of the tenure of the scholarship is spent at the Technical College, half the second year at the College and half at the Borough Electricity Works, and the greater part of the third year at the electricity works, six hours a week being given to College work.

The first holder of the scholarship has just completed his course, and the Council, in discussing the fact, raised the question whether such a training was sufficient. In reply, the borough electrical engineer stated that the scholar had acquitted himself creditably, but that, of course, the time was too short in which to train a youth for any responsible position as an engineer, and that necessarily he would have to gain a wider experience elsewhere, for which he was well qualified. The matter was allowed to drop at this point.

Incidentally it may be remarked that one advantage of this system to the scholarship holder is that he is obliged to work, and work hard, for the path is not made easy for him, as it is with so many premium pupils, to their undoing. Strict discipline and hard work make a good training ground for the engineer who hopes ever to do anything in life.

The American N.E.L.A.

The American National Electric Light Association is holding its annual Convention in Washington this year from June 4th to June 7th. As an evidence of the interest that has been aroused in the United States in reference to the proper commercial development of electricity supply undertakings, it is interesting to note that two days out of the four set aside for this year's Convention are devoted to this subject, the papers and discussions on the first day dealing with public policy and rates, and on the second day with methods of obtaining new business, and commercial matters generally.

Electricity Works Table.

With this issue we publish as a special Supplement our Annual Table of Electricity Supply Works of the United Kingdom; and we take this opportunity of tendering our sincere thanks to the hundreds of engineers, managers and secretaries through whose courteous assistance we are enabled to compile the data. There are but few new undertakings added to the list on this occasion, though a good many are on the way, and will probably be opened in time for the next edition of the Table. Practically all the larger towns and urban districts in the kingdom are now provided with a supply of electricity, so that new work of this kind is scarce, and of minor importance; but there is still great scope for development in the direction not of new generating stations, but of the extension of supply to the innumerable villages and townlets with which this country is so profusely dotted. How best to carry out this extension is an annual subject of discussion at the hands of the M.E.A. That it can and should be done, we believe, most people agree; and we trust that it will not be long before the benefits of electricity supply are extended to every hamlet in the land.

Paupers' Palaces.

All credit is due to the Local Government Board for the thorough manner in which of late it has investigated the extravagances and misdoings of certain local authorities—albeit the Board cannot be held altogether blameless in the past, for the tendency to waste public moneys, and to indulge in speculative enterprises for which they are totally unfitted, is no new feature of the proceedings of such bodies.

Unfortunately, in their zeal for the allotment of blame, the officers of the Board are liable to overshoot the mark; and we feel obliged to comment on a report made by Mr. H. R. Hooper to the L.G.B. in connection with the electric lighting installation at the Hammersmith Workhouse. The evidence given in the course of this inquiry shows, to our mind, that inexcusable extravagance was manifested in the design and construction of the buildings; and in his report on the electrical installation, Mr. Hooper suggests that this work was likewise carried out on an unnecessarily lavish scale. Taking for a basis the architect's estimate for the probable cost of the installation (but who ever knew an architect's estimate for electric lighting to be within a mile of the mark?), Mr. Hooper shows that the actual cost was about double this amount. Fastening upon the point that there are two independent sets of circuits, miscalled a "duplicate" system, he evidently considers that such a system costs twice as much as a single-circuit system, and blames the consulting engineers, Messrs. J. & J. S. Enright, for unnecessary expenditure, inferring "that the engineer wished to make the job as large as possible."

Such a policy is not unknown amongst consulting engineers; but the basis of the charge in the present instance is obviously a misapprehension. The cost of the system installed, far from being doubled, need only be greater by the cost of splitting the distributing cables in two without increasing the weight of copper used, together with the additional labour and materials for their erection. From the distribution boards to the lamps there is no extra cost whatever, and Mr. Hooper admits that the tender for the work to be done was low. The difference might amount to £300 or £400 out of a total exceeding £7,000, and the gain in reliability is certainly worth the outlay. There is nothing unusual in the system, which is quite commonly adopted, and rightly, in large buildings.

Regarding the pendant fittings, Mr. Hooper complains that these are suspended by flexible. Surely he is aware that the vast majority of pendant fittings in public institutions—and in private houses, for that matter—in this country are so suspended, and that the system is perfectly satisfactory.

In the case of certain laundry machinery, which was driven by electric motors, Mr. Hooper considers that steam should have been used, as in the general laundry; the consulting engineers, however, had nothing whatever to do with this, which was arranged by the architect. Similarly the use of a motor-generator to provide direct current for the lifts comes in for criticism, whereas the engineers had repeatedly advised the Guardians to use the public A.C. supply for this purpose.

Many other points in the report might be mentioned, such as the lack of ventilation in the subway—what have the consulting electrical engineers to do with this?—but sufficient has been said to show that serious injury may be unjustly inflicted upon the advisers of local authorities by superficial and cursory investigations of this nature.

TRADE WITH JAPAN.

The address which was delivered on Monday before the London Chamber of Commerce by Mr. E. T. Crowe, commercial attaché to the British Embassy at Tokio, was remarkable both for the information which it contained and for that which it failed to disclose. It was entitled "Trade with Japan," and although covering a tolerably wide scope, the address was disappointing from the standpoint of the industries represented by this journal. In the first place, the question of electrical trade as between Great Britain and Japan was not mentioned, and, in fact, the word "electrical" did not appear at any time in the course of the address. Not only so, but the subject of machinery and plant, electrical or otherwise, was not raised in the brief discussion which ensued on the conclusion of the address.

During the discussion, the questions of Japanese commercial morality and of opportunities for participating in Government contracts were brought forward. The former matter has recently engaged attention in different quarters, and the general answer to the charge is that "shady people" are to be met with in all countries. As a consequence, those who propose to trade with Japanese should not be dazzled by artistic letter paper having illustrations representing large business premises, but they should inquire of one of the principal banks—as, for instance, the Hong-Kong and Shanghai Bank—as to the standing of the firms or persons concerned. In fact, it is advisable to practise in Japan the same or a similar policy to that which every prudent firm follows in respect of new or unknown firms in the United Kingdom. It appears, too, that the offices of the London Chamber of Commerce have ready for consultation an official Japanese directory which is said to contain the names of firms of good reputation in that country.

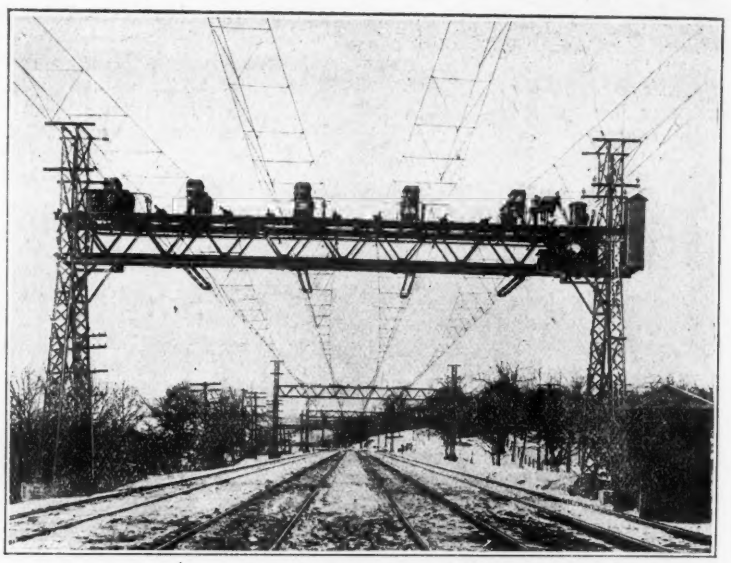
It is understood that the Japanese Government departments do not make any discrimination as between natives and foreigners in the placing of orders. It is possible to obtain orders through foreign houses established in Japan as well as through native Japanese firms. In the case of the former, a certain qualification is needed, and this is put in two or three different ways. The first is that the foreign house must have had two years' experience in tendering for government orders; the second is that the representative of a British firm might have to live in Japan for a period of two years before being able to do business with the government, this applying to firms not represented in that country; and in the third place, two years' experience of Japan must be possessed in order to be recognised by the government. Whichever way the question is approached, the condition seems to depend on a residence extending over two years in Japan.

The foregoing observations may now be followed by a brief summary of Mr. Crowe's address. Japan, we are told, is developing at such a rapid rate that a man soon becomes a "back number" unless he is constantly on the watch, and it is therefore necessary, in these days of fierce international competition, to keep a sharp look out. The total exports and imports amounted to £86,000,000 in 1906, or £3,000,000 in excess of 1905, and the progress was such that the trade was expected to reach nearly £109,000,000 in 1909. Last year there was—for the first time since 1895—an excess of exports over imports amounting to £500,000, as compared with an excess of £17,000,000 in imports in 1905. The favourable balance was caused by a large increase of £10,250,000 in exports, from £33,250,000 in 1905, to £43,500,000 in 1906, and by a reduction of £7,250,000 in the imports, from £50,000,000 in 1905 to £42,750,000 last year. Although the imports into Japan from the United Kingdom and British colonies declined in 1906, Great Britain still held the first place in imports with 24 per cent.; the remainder of the British empire came second with 18 per cent.; the United States third with 17 per cent.; China fourth with 13 per cent.; and Germany fifth with 10 per cent. On the other hand, the best customers of Japan were the United States, China, France and Corea, Great Britain occupying a lower position than these countries. At present things did not appear to look very bright, owing to the speculative wave which had spread over Japan since the conclusion of the war. At the

same time, a substantial increase had taken place in new and *bonâ fide* enterprises, as well as a large extension of existing undertakings.

The commercial attaché proceeded to state that Japan intended to become one of the important manufacturing countries, and to export largely to those Asiatic markets where she has geographical and other advantages. Japan had recently increased her tariff, especially against manufactured goods (the rate is now 40 per cent.) and so-called luxuries (the rate is 100 per cent.), and any large growth in her imports would appear to lie in raw materials and partly manufactured goods. But before Japan could attain that position it would be necessary to purchase large quantities of machinery and train her people to use and understand it, so as to get full value out of it. In this connection Mr. Crowe considered it advisable to utter a word of caution to British manufacturers. He put it in the shape of a problem, which may be rendered as meaning that when showing or selling machinery, all the secrets connected with it should not be disclosed; one or two should be kept up the sleeve.

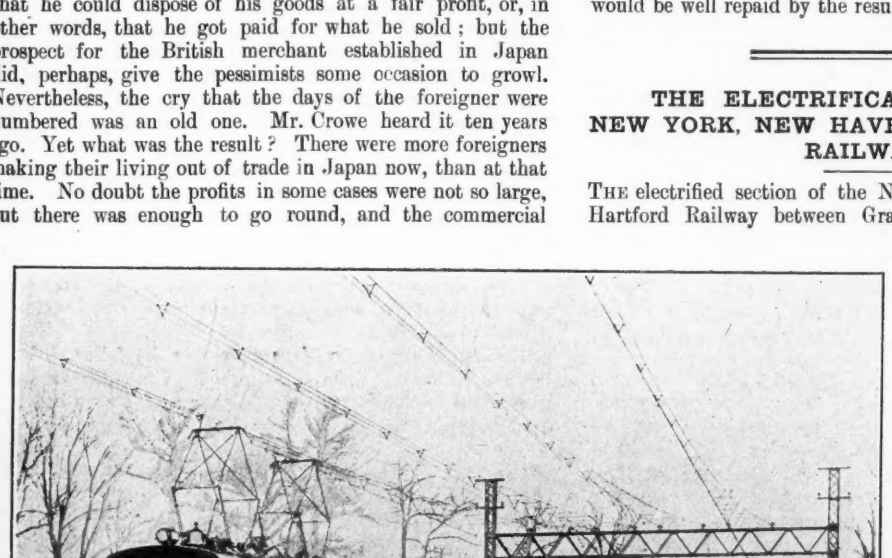
The British houses established in Japan had played an important part in financing and developing the foreign trade of the country. For some time past, however, the Japanese had wished, especially in certain lines, to do without the foreigner, and the matter had recently become more acute. As far as the British manufacturer was concerned, it probably did not very much matter how the business was done provided that he could dispose of his goods at a fair profit, or, in other words, that he got paid for what he sold; but the prospect for the British merchant established in Japan did, perhaps, give the pessimists some occasion to growl. Nevertheless, the cry that the days of the foreigner were numbered was an old one. Mr. Crowe heard it ten years ago. Yet what was the result? There were more foreigners making their living out of trade in Japan now, than at that time. No doubt the profits in some cases were not so large, but there was enough to go round, and the commercial attaché was with the optimists who believed that there was still plenty of scope for the British merchant; but he must be content with smaller profits, must be full of energy and prepared to look after trifles which he despised in the past. A greater point should be made of studying the language, and firms might do worse than give their young clerks a bonus when they passed an examination proving that they had studied to some purpose. A knowledge of Japanese was especially advantageous in regard to contracts drawn in that language, otherwise merchants were at the mercy of the Japanese. In conclusion, Mr. Crowe expressed the belief that more business could be done by judicious advertising in Japanese in Japan, and that those who studied the business would be well repaid by the results in the long run.



Anchor Gantry with Isolating Switches, New York, New Haven and Hartford Railway.

THE ELECTRIFICATION OF THE NEW YORK, NEW HAVEN AND HARTFORD RAILWAY.

The electrified section of the New York, New Haven and Hartford Railway between Grand Central terminus and Stamford presents some features of special interest at the present time. From New York to Woodlawn, a distance of 11 miles, the trains run over the New York Central Railway system, which is equipped with ordinary third-rail supply, at 600 volts, direct-current. Between Woodlawn and Stamford, a distance of about 22 miles, the New York, New Haven and Hartford Railway use their own permanent way, which is equipped with overhead trolley construction for 11,000-volt, single-phase, alternating-current. The locomotives have therefore to work both on this high-pressure, alternating current, and on 600-volt direct current. These widely varying conditions are met by the use of Westinghouse compensated series single-phase motors and electro-



Locomotive on 11,000-Volt Single-Phase Section, New York, New Haven and Hartford Railway.

pneumatic unit switch type control, the high-pressure alternating current being collected by pantograph bow trolleys from the overhead line, and the 600-volt, direct-current supply being taken from the third rail by collector shoes carried on the bogies.

One of these locomotives is illustrated herewith; the figure also shows the type of overhead construction used. This consists of a 0000 B. & S. grooved copper wire, suspended centrally over each of the four tracks. The trolley wire is supported, at intervals of about 10 ft., from two steel suspension cables at a height of about 22 ft. above the rails. The suspension cables are carried on insulators mounted on steel lattice gantries, which span all four tracks and are spaced about 300 ft. apart. At intervals of two miles a heavy gantry is placed, to which the overhead construction is anchored on both sides, and at which the adjacent sections of trolley are divided by section insulators. These anchor gantries, one of which we illustrate, are provided with switchgear to enable any individual section to be made "dead" when required. Owing to the high trolley voltage employed (11,000), no feeders are necessary, and the transmission of energy direct from the power house to the locomotives is therefore effected with the greatest economy and simplicity.

PRESENT STATE OF THE ELECTRICAL TRADE.

By AGNOSTIC.

The present state of the electrical trade is indisputably highly unsatisfactory, and calculated to afford much food for thought to those who are in a position to survey the state of affairs. The trade returns of the country, as a whole, remain good, and are improving, the general foreign trade shows a rapid increase: only the electrical portion shows a falling off. On all hands in the electrical world, depression of trade is the general lament, and one of the youngest of our industries, which started under such favourable auspices a couple of decades or so ago, is now in a parlous condition.

Abroad the exploitation of applied electrical science has led to the creation of vast firms with huge staffs, tremendous factories and a large international trade. In England such large firms as have come into being are reducing their personnel, and generally economising and retrenching with anxious eyes on their balance sheets. Keen competition, the cutting of prices, and the reduction of salaries and dividends are the order of the day.

The industry, as a whole, is less than thirty years old, yet comparing dividends earned with depreciated capital, it must be admitted that its working has not been so profitable as it should have been.

In 1900 the total amount of capital invested in the electrical industry was £123,000,000. This was disposed of among the four branches roughly as below:—Telegraphs and telephones, £40,000,000; tramways, £28,000,000; electric light supply, £26,000,000; manufacturing, £21,000,000.

The last item is the only one that represents trade in the strictest sense of the term, and it is with this that we propose to deal in the present article.

An examination of the causes which have culminated in the present state of affairs necessitates a review of the rise and growth of the trade. The year 1880 may be said to have seen its birth. For a long time the great bulk of the trade done consisted in the factoring of German and American goods. In consequence of the discouragement given to supply station enterprise by antiquated and grandmotherly restrictions, the whole industry here was held back in a manner which enabled Germany and America to get a very strong lead, which they have never relinquished. The best way to make money in those days was to get an agency for some well-made foreign goods, by which large profits could be made. Home factories, however, gradually arose, and with one temporary set-back, the trade generally prospered until 1897-9, when it may be said to have reached its high-water mark of prosperity. The period immediately following this was marked by the introduction of new capital on a large scale; new factories were opened, and old-established concerns hastened to extend their scope. This was the beginning of the present depression. The natural course of the trade did not warrant this rapid expansion; manufacturers have found that they over-estimated their markets, with the result that, at the present time, the manufacturing side of the industry is heavily over-capitalised, to the detriment of every other branch. Since 1900 a great struggle has been going on—a struggle to find work for new factories, and to earn returns for new capital. A senseless cutting of prices has followed, our captains of industry seem to have regarded the taking of orders at cost price "to keep the factory going" as a particularly acute piece of masterly policy. The disproportionate preponderance of trade done over profits earned, as shown in the published balance-sheets of the large companies, illustrates this point most forcibly.

The causes that have led up to this state of things are many and complex. Principal among them is the one great fact that the designing and the manufacturing of goods have not been in the same hands. The consulting engineer has acquired great power in this country, owing to unbridled municipal ambition. The promotion of supply stations by corporations and municipalities has fostered the growth of a body of professional designers and advisers, who naturally draw up specifications based solely on their own knowledge and experience. The direction of general manufacturing has thus been committed to the hands of a body of learned theorists, who lead the way with a lordly disregard of the economics of manufacturing. Each individual is a law unto himself, placed by circumstances in a position by virtue of which he is tempted to give rein to his own idiosyncrasies, for the average man is prone to consider he is sacrificing his own individuality if he condescends to fall into line with his compeers. An entire absence of unity has been the result, standardisation has been retarded, and production on a large scale has proved impossible. In America, the manufacturers have had the designing under their own control, due regard has been paid to economic conditions, and standardisation is general.

An instructive commentary on the above is presented by last week's technical journals, in the columns of which the reports of two great companies appear side by side—one English and one American. The English company's position is shown by its chairman's statement that "the producing power of English factories was far in excess of the demand." On the other hand, the American company's sales are shown to be 50 per cent. more than those of the previous year.

One of the principal features of the recent changes has been the extinction of a vast number of contractors, coupled with the opening of contracting departments (usually as quietly as possible) by the manufacturers. It is an open secret that most of the wholesale houses have been for some time competing with the retailer on his own ground, and in this connection, the latter has come in for a deal of criticism as to his incompetence. The contractors, however, have been oppressed by those to whom they should have been reckoned indispensable. They have had competition, their foremen have set up in opposition, the ironmonger, the furniture dealer, and the stores have done their worst, but the contractors could have withstood them. It was the competition of their suppliers that formed the last straw.

In any healthy trade, the firms engaged therein can be divided into manufacturers, factors or wholesalers, and retailers. Each section represents a distinct organisation, each employing a different class of man, and calling for a different style of training. The two first are often combined under one name, but they are always distinct; the manufacturing and the selling organisations are necessarily separate the goods have to bear the factors' distributing profit after leaving the works at a profit. The retailers form the "feelers" who are in touch with the actual consumer, and who place the goods in their final owners' hands. In England this latter is the most delicate part of all the machinery of trade. The relations between the retailer and the consumer are usually of a semi-personal nature, and the place of the former cannot be supplied by any scheme on American lines, however comprehensive or expensive. The connection of the shopkeeper, and the capital value of his local reputation, and his experience in his own sphere cannot

be supplanted by any vaunted "publication scheme" or advertising campaign. It is here that the weak spot in the electrical trade lies. The absence of efficient retailers is the cause of the difficulty experienced in trade expansion, and the stifling of the contractors has been the most fatal step on the part of the manufacturers. With unwieldy capital on which to pay dividends, the manufacturer has grabbed business anyhow and anywhere, and it is this suicidal competition with all and sundry that has placed the trade in its present position.

Taking the absence of means of distribution as the root of the present trade stagnation, and considering it in conjunction with its prime cause, namely, frenzied competition among manufacturers, the next step is to remedy the evil. Surveying the most apparent difficulties confronting the seller both of goods and of electricity, it is plain that the problem of getting in touch with the public is beginning to be felt very keenly. The local exhibition has been worked for all it is worth. Publication schemes and American business-getting methods are finding advocates in all directions. At one time it seemed as if the place of the retailer was going to be taken by the supply station, and as if the electrical trade were going to follow in the footsteps of its most formidable competitor—gas. Showrooms appeared, attached to borough electricity offices, and engineers took advantage of competition among manufacturers to stock them free of charge, the goods all being on sale or return—usually the latter. But there are many signs now that municipal trading has received a decided check, and there seems to be an unmistakably pronounced wave of public opinion against any further extension in this direction. Apart from this, however, such enterprises are foredoomed to failure, for municipal engineers are rarely business men, and never have command of a set of trained salesmen. Moreover, no system of retail trading can advantageously be grafted on to any other branch of the industry. These are the days of specialisation, and neither the current-canvasser nor the wholesale commercial traveller is fitted either by inclination or training for the difficult post of salesman to the public.

The highest interests of every branch of the trade call strongly for the encouragement of such retailers of position as are left. If manufacturers and central station engineers will recognise the value and status of the contractor, and loyally support him, it will eventually tend to the ultimate advantage of both, and aid in the reconstruction of the retailing branch of the trade on a sound basis. The industry demands less consulting engineer and more contractor. This is the position in a nutshell. At the same time, the key to the situation rests with the manufacturer. The policy of the latter has been hitherto to pet and nurse the consulter, treating him as a little god, while the poor contractor has been treated as an interloper—a poacher on trade. This policy must be reversed. The consulting engineer system has put back the industry ten years—the want of efficient retailers bids fair to keep it back another ten. Manufacturers must act decisively at the present opportune moment, and direct their policy towards one end—the rehabilitation of the trade.

As a preliminary to this, some sort of agreement is necessary in the manufacturing world. Competition needs tempering. There is enough work to go round, and if everyone's prices were raised to a remunerative basis, the work would be distributed just as now, but at a greater profit. Surely the exciting game of selling motors at bare works' cost is beginning to pall. Is not the time gone by when to "cut in" and get an order on a 5 per cent. basis is esteemed exceedingly knowing and cute? The cablemakers have long learnt this lesson, and as a result—witness their dividends. The conduit makers have recently arrived at some arrangement. Why cannot more hatchets be buried? The crass conceit and blind self-worship of some heads of firms, acquired during days of unlimited prosperity and motor-cars, must by this time be sufficiently dissipated to enable them to see that splendid isolation has its disadvantages. One's thoughts naturally turn in this connection to the Manufacturers' Association, an association that has been chiefly regarded as useful by many members as a means of throwing dust in the eyes of competitors. This association contains the germs of harmony; it only needs galvanising into effective life by some real effort on the part of its members towards co-operation. If some of the energy at present wasted on Protection campaigns were turned into this channel, and devoted to setting our own house in order, a deal of good might be done.

Protection would not do the trade much good, English electrical goods hold their own everywhere. The foreign standards differ from English requirements, hence the bulk production of the foreigner does him no good in competing for English markets. The Protection bogy is usually raised by the incompetent. It would undoubtedly keep the foreigner out, but the relentless competition at present raging is mostly among our compatriots, and a tariff to-morrow would still leave us at each others' throats. Internal reform is called for.

Rumours are rife just now as to many schemes to supply the deficiency, so keenly felt, in getting goods before the public. Manufacturing firms are reported to be stepping into the breach with brand new organisations, with ramifications throughout the country. Supply stations are said to be discussing "international" showrooms *ad nauseam*. The defects of such schemes lie in the capital they require. The industry will be hard pressed during the next few years to pay on its present capitalisation. Every effort should be made by those who look ahead to utilise to the utmost the instruments ready to hand, to organise the trade as a whole, and to restore it or convert it to a harmonious selling machine.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Electrical Trade.

Your leading article on the above has been read by me with considerable interest, and possibly a few lines on the condition of the electrical trade in South Wales may be equally interesting to your readers. Your simile of the child is good, but I would liken the trade here to an intoxicated youth, stumbling along with uncertain steps, elated with his own importance, but a degrading spectacle to his fellows. The chief field for electrical work here is in the mines, and the business is mostly done on the following lines.

A colliery proprietor suddenly wakes up to find that electrical power would be an advantage in working his mine, and he gets into communication with half a dozen electrical manufacturers. The worthy representatives of these firms pounce upon him with their catalogues and literature, and each one—whether he understands the matter or not—advises his prospective client to do this or that, putting forward the most impossible schemes to score a point over his competitors. In a short time another batch of contractors have heard that there is a job going, and they come along with their suggestions. In the course of about 12 months, the client is surrounded by a score of firms, all eager to carry out his contract, and if he has survived the ordeal of numerous interviews, he picks out a few of the lowest tenders, and refers them to an indifferent consulting engineer for a report, which when received is promptly ignored, and as a general rule the order goes to the firm who tender lowest. It is a common thing for the client to take from 12 to 18 months to place his order, and the firm who are foolish enough to accept the same lose money on it, and give him a cheap and nasty job, The finale is a certain loss to the contractor, an indifferent job for the client, and as often as not an arbitration case.

I personally know of instances where 22 contractors have tendered for a job worth about £2,500, the order has been placed after 18 months' bartering, the fortunate contractor has lost £1,000 on the contract, which has been 12 months' late in completion, and the whole thing has been a disgrace to the profession. The largest firms here represented seem to be the biggest sinners, and the foreigners are as keen as the home birds.

It appears to be increasingly common for some firm or firms to take a contract at a loss, and as often as not make a mess of it, rather than let a competitor have it at a reasonable price.

Twenty and 25 per cent. difference in price for the same job is common here, and the firms that are doing the most work evidently are losing the most money.

Another point is that too often the contractor is saddled with sub-contracts, such as engines, pumps, haulages, and even boilers, on which he can make no profit, because the makers themselves tender direct at the same price.

The reason for this chaotic condition of affairs is chiefly the excessive competition, which induces manufacturers to get business at any price and at any cost, but to get it.

The remedy is difficult, but an understanding should be come to by the British firms on the lines of a combination, whereby their administrative expenses would be reduced and their prices maintained, or else South Wales will be a sorry place for many a day.

In the meantime, the "intoxicated youth" continues to stagger on to his unknown destination, and should he reach it sound in body, he will realise, when he is sober, that intoxication is the sport of fools.

An Interested Spectator.

The Wiring Cost of Small Houses.

Allow me to congratulate Mr. Seabrook on his straightforward letter of the 24th ult. Would that there were more engineers of the same calibre willing to help instead of hindering contractors.

Only too often the latter are consigned to the tender (?) mercies of a subordinate, who, moreover, has occasionally been known to have a predilection towards a favoured *one*. I feel sure it would greatly benefit electricity departments if chiefs, instead of looking down upon contractors as "miserable worms," would climb down and treat them as brother workers in the cause.

It does not require much reasoning to see that contractors are the best canvassers and advertisers that a Council can have, and consideration shown to them will return fourfold to the chief who encourages contractors as a body to popularise his undertaking, and who reciprocates by putting work in their way.

It is, I believe, Mr. Seabrook's custom to supply all contractors in his district (at least, those who cater for the "casual" work, as distinct from "estate" work) with a list of all inquirers for electricity, and to help these long-suffering creatures in every possible way—with the result that most of us can see. Hoping that other engineers will not be above taking Mr. Seabrook's lead, I remain, meanwhile,

One of the Worms.

PROCEEDINGS OF INSTITUTIONS.

The Oxidation of Atmospheric Nitrogen.

The *Journal of the Society of Chemical Industry* for April 15th last contains a paper read by Mr. F. Howles, M.Sc., before the Manchester section of that body, entitled the "Electro-Thermic Combustion of Atmospheric Nitrogen." As its name indicates, Mr. Howles' communication deals only with methods for converting nitrogen into nitric acid, the ammoniacal processes being omitted. At the outset the author states that the first consideration in the technical production of nitric oxide from an economic point of view is the attainment of an arc of the highest possible temperature, whereby both high nitric oxide concentration and high reaction velocity ensue. The ordinary high-tension arc playing in air consists of three zones; the lowest carries most of the current, and reaches the highest temperature, probably in the neighbourhood of 4,200° C. Is seems probable that the oxidation of the nitrogen takes place in this zone only. The middle zone, greenish blue in colour, has a temperature of at least 1,400° C.; in it a complete dissociation of ozone occurs, and also a partial dissociation of nitric oxide. The third or highest zone is the largest; it has a pale yellowish colour, and a temperature of 900° to 1,000° C., according to Muthmann and Hofer, although the author believes this measurement to be too low. Presumably a further dissociation of nitric oxide takes place in this cooler zone. Certainly the nitric oxide cannot be oxidised further to nitrogen peroxide, because the latter body decomposes entirely below 600° C. Hence a second condition for the economic production of nitric oxide is that the gases be removed from the arc as quickly as possible after the reaction has taken place, that is to say, the gases must be cooled very rapidly before decomposition has time to occur; while a third condition is that the relative volumes of the two upper zones of the arc shall be reduced as much as possible, and the capacity of the first zone increased. The fourth important consideration is the concentration of a large amount of energy in a unit of plant. With the ordinary high-tension flame it is not advisable to use currents of more than 0·1 to 0·2 ampere, or the yield of nitric oxide may be diminished; but since the yield of oxide is a function of the energy consumed, and the reaction $N_2 + O_2 = 2NO$ requires an expenditure of 42,300 calories, a plant constructed for the utilisation of a large number of low-current arcs would entail the erection of an enormous number of units, and the upkeep and labour charges of such a plant would necessarily be high.

Turning to the technical processes that have been proposed for the manufacture of nitric acid, Mr Howles briefly mentioned those devised by McDougall and by Bradley and Lovejoy, both of which are of merely historical interest. In the process worked out by de Kowalski and Moscicki, the output of nitric acid is said to be increased by augmenting the frequency and voltage of the current. It is claimed that a maximum output of 440 kg. per KW.-year can be obtained from a current of 0·05 ampere of 6,000 to 10,000 cycles per second at 50,000 volts. If worked commercially, however, this process would require a large number of units of plant, since only 2½ KW. are absorbed in each of them. Mr. Howles next proceeded to deal with the Birkeland and Eyde process, which has already been described in these columns. He mentioned that it had given a yield of 600 kg. of nitric acid per KW.-year; and that for a furnace designed to take 1,000 KW. the cost of installation only amounted to £1 per KW. The scale on which this process is being carried out at Notodden is now being enlarged, and it is proposed to use in the manufacture of nitric acid 27,000 E.H.P. developed from water-power. The cost of producing 1 ton of calcium nitrate containing 13·2 per cent of nitrogen is reported to be £4, whilst the selling price is £8, calculated upon a market price of £10 per ton of combined nitrogen. The Badische Anilin und Soda Fabrik has taken out a patent for the use of a magnetic field which spreads out the arc, a transformer being employed to avoid the necessity for using a separate current to excite the magnet. In a later patent, arcs of great power are obtained by having an iron tube 3 ft. or more long, at one end of which an insulated electrode is situated, while a single electrode electrically connected to the tube is inserted at the opposite end. On passing a current at some few thousand volts an arc is established between the insulated electrode and the wall of the iron tube. If air is blown into the tube with a whirling motion, the arc travels along the wall to the opposite electrode, burning steadily as long as the current of air is maintained. A process has been devised by Naville and Guye, in which a disk-shaped electrode in a cylinder of refractory material is revolved over a metal tube which forms a second electrode, the arc being thus spread round the periphery of both tube and disk. By this method a yield of 400 kg. of nitric acid has been obtained per KW.-year. In Pauling's apparatus, straight or curved fixed electrodes are inclined to one another in a vertical plane, while solid conductors fixed on the circumference of a revolving wheel pass between their lower ends.

Glancing through the above processes that have been suggested or actually employed, it will be found that the greatest output of nitric acid yet obtained is 650 kg. per KW.-year; which, assuming a mean flame temperature of 3,200° C., is equal to 79·3 per cent. of that theoretically possible. Further investigation is needed to ascertain whether this quantity can be increased by raising the mean flame temperature or by removing the gases more rapidly and cooling them suddenly. The spreading of the current paths by magnetic force should tend to equalise the temperature of the flame, and so to prevent its gradual reduction; but, on the other hand, the energy required to maintain the magnetic field amounts to 10 per cent. of the quantity consumed in the arc. Experiments by Muthmann and Hofer on the effect produced by increasing the pressure of the gases round the arc from 1 to 1·4 atmospheres show that the velocity of the air passing into the arc chamber can be thus accelerated, and that, although the exit gases contain the same percentage of nitric oxide, yet the yield is increased threefold per unit of energy consumed. Against the increased yield, however, must be set the cost of compressing the gases and the difficulties always met with in practice when working at high temperature under pressure.

The gas leaving the furnace contains about 2 per cent. by volume of nitric oxide, which is rapidly converted into peroxide by means of the surplus oxygen present. The gases are then passed through absorption towers charged with water or dilute acid, and finally through a special tower in which milk of lime is used; thus an acid is obtained of about 50 per cent. strength. Various difficulties arise in concentrating this acid, so as to obtain a material free from nitrous acid. It must either be mixed with concentrated sulphuric acid and distilled, or a nitrate must be prepared and distilled with sulphuric acid or a bisulphate. An electrolytic method has lately been patented for concentrating and oxidising the weak acid, which consists in refrigerating the oxides of nitrogen evolved during the electrolysis at the cathode, and leading them in a liquid state slowly to the anode compartment of the cell, where, in the presence of the nascent oxygen, a solution of pure nitric acid free from nitrous acid results. The author is unable to state whether this process has proved satisfactory, and he considers that, although the electrothermic acid production of nitric acid has attained a fair degree of efficiency, the problem of manufacturing a 98 per cent. acid from the furnace gases has not yet been solved.

Mr. Howles brings his paper to a conclusion by discussing the expenses involved in generating electricity for the oxidation of

atmospheric nitrogen. He considers that the figure £2 said to be the cost per KW.-year at Notodden is probably under-estimated, as the plant has not yet been at work long enough to enable the depreciation and the cost of upkeep to be accurately measured. According to a statement in one of the *Times Engineering Supplements*, the cost of energy at the Christiania electrical works, run by water-power, for labour and lubrication alone is £7 18s. 6d. per KW.-year, to which fixed charges have to be added. The lowest price charged at Niagara Falls is £10 4s. 6d. for quantities of not less than 1,200 KW. On the other hand, Wein has asserted that energy can be developed in Norway and Sweden at £1; at large falls in Switzerland and Austria for £2; at Niagara for £4; and at small waterfalls in Austria for £6 per KW.-year. The same amount of energy can be produced from steam engines in south-east Lancashire for £6 per year of 8,760 hours, while some tests carried out in London on a gas engine supplied with producer gas made from coke show that a KW.-year can be developed for £6 2s., including all charges. On this basis one metric ton of nitric acid would cost £10 6s. 8d. Much greater economy can be obtained in larger plants employing the Mond producer, for according to Guye, with fuel at 7s. per ton, a KW.-year should cost £3 13s. 6d. Yet further economies are to be obtained by the use of blast-furnace gases. In 1902 about 340 blast-furnace gas engines were in use in Germany, developing altogether 200,000 H.P. Since that date another 100 engines, each of over 1,000 H.P., have been installed. Very favourable reports have been published of the condition of the cylinders in these engines, even after running for a period of two years, in spite of the dust in the gas. Mr. Howles calculates that the capital outlay on blast-furnace gas engines per KW., including buildings, &c,, is £10. He allows interest and depreciation at the rate of 10 per cent., takes upkeep at 6s. 8d. and labour at the same amount, and so considers the total cost of the energy, excluding the cost of the gas itself, to be £1 13s. 4d. per KW.-year. This amount is to be compared with £4 as the average cost of water-developed electricity, with £6 for steam electricity in Lancashire, and with £3 13s. 6d. for Mond gas electricity.

In the course of a discussion following the paper, Dr. R. S. Hutton objected strongly to Mr. Howles's comparison of the cost of water-power, of steam, and blast-furnace gases. He stated that the present small nitric acid factory at Notodden was actually purchasing its energy at about 33s. per KW.-year, while many works, both in Norway, Sweden, and in the Alps had an inclusive cost ranging from 16s. to 40s., the latter being considered in these countries the maximum permissible for such industries as the manufacture of aluminium, chlorate, and carbide. Power at Niagara had been sold for some years past at from £4 15s. to £5 10s., and had always been considered expensive. With reference to gas engines, and in particular to those cases in which blast-furnace gas was used, although much development might be expected in certain directions, *e.g.*, the manufacture of electric steel, the enormous capital expenditure, and the actual results obtained by those who had laid down gas engine plants in this country seemed to indicate that the statements made by Mr. Howles were very optimistic. Dr. Hutton regarded the electrochemical production of nitrates as a most promising development, but in ordinary circumstances it must of necessity be confined to those countries where facilities for the development of cheap water-power were exceptionally favourable. Replying to Dr. Hutton, Mr. Howles granted that the capital outlay was the main charge in developing electrical energy, and he did not feel certain whether an adequate sum had been set aside for upkeep, interest on capital, and depreciation in the estimates ranging from 30s. to £2 per KW.-year, which were quoted by Dr. Hutton. If these charges were not correctly apportioned, the estimates would be very materially affected. It was well known that the capital outlay on water-power plants was much higher than that required to "harness" blast-furnace gases. He had based his calculations upon figures obtained in actual practice, so that, excluding the cost of the gas itself, they must be correct.

Underground Mains.

THIS discussion on the paper by Mr. W. M. ROGERSON (reported in our issue of April 19th) was resumed at the next meeting of the Leeds Local Section of the INSTITUTION OF ELECTRICAL ENGINEERS.

Mr. G. G. L. PREECE said he was quite in agreement with Mr. Rogerson as to the desirability of using a soft and sticky compound which would flow quite easily at high temperature, and therefore get into every corner of the box, and yet form a solid compound with no tendency to run away at all ordinary working temperatures. Mr. Dickinson would certainly be able to use his fittings again, if using a sticky compound, by the application of a little paraffin. The speaker's firm used the soft and sticky compound known as "diatrine" both for low and high tension work. The Admiralty had decided to use paper lead-covered cables for their large mains on battleships, &c., and as these mains had to run through very high temperatures, they had recognised that a good deal of the success of paper cables must depend upon the quality of the insulating compound to be used in the joint boxes. With that object in view, the Admiralty had issued a very strict specification for such compound, and to meet it his firm made H.M.P. compound (High Melting Point Compound) which had been consistently used for some time with great success in boxes placed vertically at high temperature and under damp conditions. This compound was tough and not brittle at temperatures varying from 50° F. to well over 200° F.; it ran freely when melted; the point at which the compound flowed was very high indeed, and the coefficient of expansion was small. Mr. Rogerson spoke of the electrolytic action on lead-covered cables; there was certainly a good deal of this going on, and to overcome it they must either insulate the cables altogether, or have the lead sheathing continuous and bonded. The former method seemed to be almost impossible. The source of current which was most likely to cause electrolytic action was the leakage current through imperfectly made joints or end connections. Some large towns had had trouble with lead-covered cables, due to large rushes of current along the lead of the cable, amounting to thousands of amperes, caused in the first place by a heavy short-circuit fault. The effect was to burn away the bonds, and at times arcing at the joints or boxes occurred. Holes were burnt in the lead covering at those, but the faults did not appear immediately, but presented themselves at odd times during the next few weeks or months, according to the amount of moisture present at the various spots. One very large town had in consequence thrown out lead-covered cables, but recognising the value of paper insulation, had gone in for the type of cable known as paper leadless cable—that is, paper with a sheath of bitumen. Lead sleeve continuous joints should, however, cure the trouble. Rubber cables were made far more satisfactorily now than they were 12 years ago, but a great deal of harm was taking place, due to the use of cheap rubber cable, especially in house wiring, and in time its effect would be prejudicial to the increase of electric lighting in houses. The usual wiring and installation rules issued by Corporations specified an insulation resistance test after the building was wired, which was practically useless. Bare wire in dry buildings would probably pass this test. Other rules specified 300 or 600-megohm wire; they did not say 300 or 600-megohm grade to British cable-makers' standards, or, at least, only one or two did; that would be getting in the right direction. A paragraph should be inserted in the rules specifying that a definite amount of hard fine pure Para rubber should be used in the wire or cable, the compounds to consist solely of such Para rubber mixed with sulphur and mineral matter only. The proportion by weight of such hard fine Para should be at least 30 per cent. for all voltages up to 250 volts, while in the case of 500-volt cables this weight should be increased to 40 per cent. Where such clauses were adopted—as at Glasgow and Edinburgh—there they found the best installation work and the best type of contractors. Practically all the rubber wires and cables his firm sold in Scotland were of Association grade, and most of that was 2,500-megohm grade. In regard to bitumen cables, there certainly would be trouble where they came into direct contact with alkaline matter. Bitumen cables were best when laid on the solid system. The decentralising of such cables seldom occurred after laying, unless heat and pressure had been applied locally; this decentralisation, however, was practically got over by the use of paper as an insulating separation with a bitumen sheath overall—the type of cable known as paper leadless cable. This type of cable was very popular, especially on tramway work; there was no fear of electrolysis with it, and the paper enabled the cable to withstand the overloads, which were bound to happen on tramway work, far better than a purely bitumen cable; further, they got a higher insulation resistance. The most satisfactory solid system was the asphalt troughing, mainly because no bridge pieces were used; also its insulating properties rendered it the best trough for lead-covered cables, as it practically prevented electrolysis. Asphalt bridge pieces were excellent. He did not like iron bridge pieces. The armoured lead-covered paper cable, laid direct in the ground with lead sleeve joints, was rather a favourite of his; probably the cheapest, and quite as efficient as any other type of cable. Such armoured cable should have the protective materials well impregnated with compound; the lead should be compounded, steel tape or wire armour also, and the jute. In England the climatic conditions were altogether against the system of bare copper laid solid. There was trouble due to moisture getting in at the ends and travelling down the strands of the cable. A cable designed to prevent such trouble had the interstices between the strands of the conductor filled up solid with a special solid compound, which would not run or become displaced when overheated. The mode of manufacture was to coat the centre wire of the stranded conductor with a thin covering of special compound; the six wires forming the seven-strand were then stranded over it, another covering of special compound was put on, and so on. This was particularly recommended with bitumen cables, and was practically a preventative against men's carelessness in leaving ends open and unsealed. Regarding the relative costs of multicore against three single cables on the three-wire system, the three single cables came out cheaper, and he thought them more convenient and efficient. Plumbed lead sleeve joints were better than ordinary joint boxes for straight joints on lead-covered cables, especially for high-tension work. A cast lead sleeve which had been put on the market by Messrs. Glovers, of Manchester, might be used on straight joints. A description of it appeared recently in one of the electrical journals.*

Mr. S. D. SCHOFIELD said he was quite in agreement with Mr. Rogerson upon the main points. For feeders for lighting purposes, he preferred triple-concentric lead-covered mains with plumbed joints, and for distributors, single-core cables, precautions being taken to keep the lead continuous. Underground disconnecting boxes were a source of continual trouble, and it was by far the cheapest to put pillars overground; where distributing cables were tapped on to feeders, he fused the distributor through porcelain switch-fuses, which had given no trouble when using fine copper wire in parallel, each wire enclosed in an asbestos sheath. The ends of distributors fed from different points were joined through fuses at, say, 50 to 80 per cent. of the capacity of the cables.

* ELECTRICAL REVIEW, February 8th, 1907, p. 214.

MR. YERBURY agreed that the lead should be continuous throughout, with plumbed joints, avoiding as far as possible cast-iron boxes filled with compound.

MR. CRIDGE, referring to the aluminium fuses in contact with copper, asked for further information as to the action that took place.

MR. R. H. CAMPIAN asked the author how he was able to earth the steel tape as well as the lead. He had found aluminium fuses the best for feeder pillars, but had experienced trouble in connection with an atmospheric deposit on the fuses; he had tried polishing the aluminium fuses with blacklead, and it gave very good results.

MR. E. J. MARSH had used lead-covered rubber cable for feeding trolley lines, and found some lengths pit badly. He asked whether vulcanised bitumen cable, heavily braided and finished with fireproof braid or tape, would be preferable. With regard to the earthing of the lead of tramway cables, one difficulty that arose was that of dealing with the negative cables to the rail, especially in places where the rails were some distance from the power station. In this case, when a fault developed on the negative cable with a difference of potential to earth of, say, 5 to 15 volts, and the whole of the leads were coupled together, the whole of the cables were affected, with a liability of damage, the low pressure and the conditions of tramway working making it difficult to discover the existence of the fault, which did not show itself on the station instruments under ordinary conditions. He agreed with Mr. Preece that for cast-iron joint boxes, it was not advisable to use unskilled labour for filling in the compound.

MR. G. D. ASPINALL PARR thought the single-core cable the most satisfactory for distributing purposes, and advocated the magnetic cut-out as more reliable than fuses.

MR. W. M. ROGERSON, in reply, referred to an instance where one end of a feeder came into the sub-station, and they had a tremendous amount of trouble with the compound, which was poured into the cable-end box, leaking, as the cable end was in a downward position; they simply overcame the difficulty by turning the end up the other way! With regard to the tests for rubber cables, no doubt a large amount of cheap cable was used for house wiring, but he failed to see how Mr. Preece's suggestion would get rid of it; there was apparently great difficulty in testing the purity of rubber. In his opinion the cable makers were greatly to blame for making inferior cable, and should have stuck to the C.M.A. standard instead of bringing out an inferior grade. He did not approve of iron bridge pieces. He did not advocate the earthing of the leads at the power station; if the station was far away from the track it would be inviting trouble. The polishing of the aluminium fuse with black lead certainly did prevent the pitting action at the contact of copper with aluminium, but beyond that he could give no further information. There was no difficulty in making a plumbed joint on to the steel at the same time as on the lead. They had done this with an extra high-tension cable, lead-covered, steel-taped and armoured and laid direct in the ground, a joint being made in the lead and steel every 400 yd. in a length of seven miles. With regard to cabling for tramway poles, which Mr. Marsh referred to, they always used ordinary 2,000 meg. rubber cable, and had had the same trouble mentioned by him, with several blisters on the insulation of one length of cable. He would certainly not advise vulcanised bitumen cable for use inside the tramway poles, and could not recommend anything better than rubber for this purpose. Magnetic cut-outs had been tried in several places, and in the end it had been necessary to tie them up, especially in section pillars for tramway purposes. They were not at all reliable, often acting when they were not required, and failing to act when they were required, owing to corrosion. For mains work it did not much matter if a 200-ampere fuse blew at 200 or 300 amperes, as long as it could be relied upon to blow when necessary, as in the case of a heavy short or earth.

The clause in the Halifax Corporation Act of 1900, which referred to the attachment of brackets to buildings for tramway purposes, mentioned by Mr. Raphael at the last discussion, was as follows:—

"The Corporation may, with the consent of the owner of any building, attach to that building such brackets, wires, and apparatus as may be required for the working of the Corporation tramways by mechanical power. Provided that—

"1. Where, in the opinion of the Corporation, any consent under this section is unreasonably refused, they may appeal to a petty sessional court, who shall have power to allow the attachment subject to such terms as to compensation or rent, and otherwise, as they may think reasonable in the circumstances, or to disallow the same, and may determine by which of the parties the costs of the appeal are to be paid.

"2. Any consent of an owner, and any order of a Petty Sessional Court under this section shall not have effect after the owner ceases to be in possession of the building, but any attachments fixed under the provisions of this section shall not be removed until the expiration of three months after any subsequent owner shall have given to the Corporation notice in writing requiring the attachments to be removed. Where such notice is given, the preceding provisions of this section shall apply, and the Petty Sessional Court shall have the same powers as under proviso (1).

"3. The owner may require the Corporation to temporarily remove the attachments where necessary during any reconstruction or repair of the building.

"4. For the purpose of this section, any occupier of a building whose tenancy exceeds one year unexpired, and in the case of any other tenancy, the person receiving the rack rent, shall be deemed to be the owner."

The Use of Wooden Poles for Overhead Power Transmission.

By C. WADE (Hull).

(Abstract of paper read before THE INSTITUTION OF ELECTRICAL ENGINEERS, *May 2nd*, 1907.)

IT IS an easy matter to make electricity cheaply wholesale, but it is only by the use of overhead mains that it can be cheaply retailed over large areas. The power companies soon found that, in many cases, the cost of underground mains made it unremunerative for them to connect customers whom they needed and who needed them. The Lancashire Electric Power Co. approached the Board of Trade, and were met by the authorities in a most friendly spirit; to-day the company has about 4½ miles of overhead mains transmitting power at 10,000 volts pressure to a variety of industries. The lead of the Lancashire Power Co. was quickly followed, and there are now some 55 miles of extra high-tension overhead transmission lines at work in Great Britain.

In the districts round Grenoble, Lyons, and at St. Etienne, to give only one example, there are some 700 miles of overhead power mains at work carrying energy at pressures varying from 200 to 26,500 volts.

One overhead line near St. Etienne, 11 miles in length, carrying energy at 5,500 volts pressure, was erected for £160 per mile, and this sum included wayleaves, special precautions when crossing roads and railways, and the purchase of trees that were in the way of the line. It is interesting to note that some 4,000 silk looms are connected to these mains, divided amongst hundreds of peasant proprietors who own from two to ten looms each. This is a very striking example of the benefits of cheap electrical power rendered possible by the employment of overhead distribution.

The author, in August and November, 1906, acting on the suggestion of Mr. A. P. Trotter, of the Board of Trade, carried out an exhaustive series of tests on wooden poles of varying form, lengths,

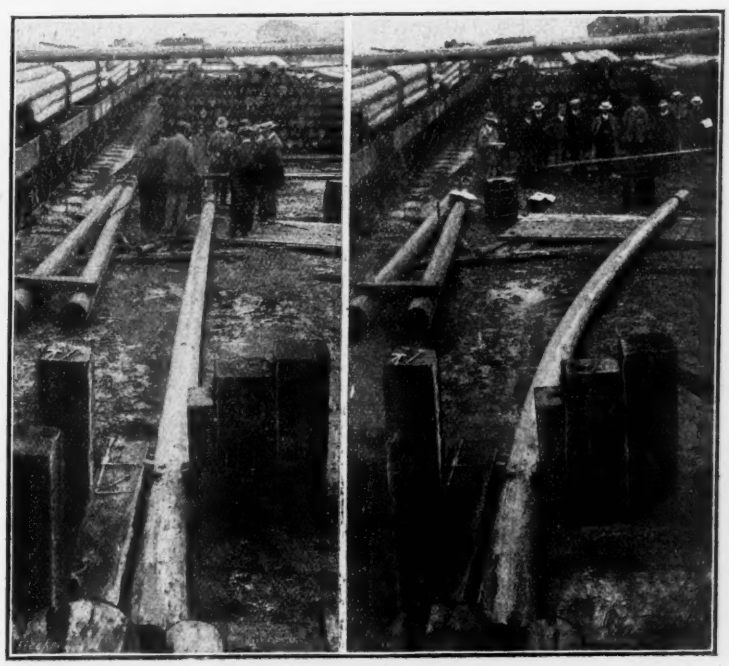


FIG. 1.

and diameters. During these tests the author had the advantage of the advice and help of Prof. Goodman, of Leeds, and the tables printed with the paper were prepared by him.

These tests clearly proved: First, the very marked superiority of an "A" over a single pole, the "A" pole being shown to be at least three times as strong as a single pole, while later and more accurate tests have shown that the "A" is at least four and a half times as strong as a single pole; secondly, the great flexibility and recuperative power of wooden poles (fig. 1). Some single poles

that were tested projected free for 35 ft. from their housing and deflected 13, 14, and 15 ft. before breaking; and those that were released before the breaking-point was reached showed a very small permanent set. It was soon seen that "A" poles were preferable to single poles as regards both economy and strength. To obtain the required strength in single poles, they would have to be of such a diameter as to be prohibitive in cost, and in some cases unobtainable.

When it was found that the strength of "A" poles was the really important point to determine, the author, acting on Prof. Goodman's suggestions, re-designed and reconstructed the testing apparatus and the methods of housing the poles, and carried out a new series of tests in December.

In this series of tests—confined almost entirely to "A" poles—a different method of holding was adopted to prevent the poles from slipping in their housing. All the poles were about 7½ to 8 in. diameter at 5 ft. from the butt. The pole was very rigidly held in place, in fact, far more so than would occur in actual practice.

Prof. Goodman suggested and provided a telescope, which was attached to the butt of the pole, and by this means it was possible to sight a plumb-bob, so that accurate readings could be obtained, and any slip of the pole in its housing could be detected and allowed for.

The load was applied in the same manner as in the first series of tests—by pulley blocks—and everything possible was done to eliminate friction. The weight of the pole was taken at the top end by a chain hung from a large pulley running on an overhead cross-pole, supported on tripods at each end (fig. 2).

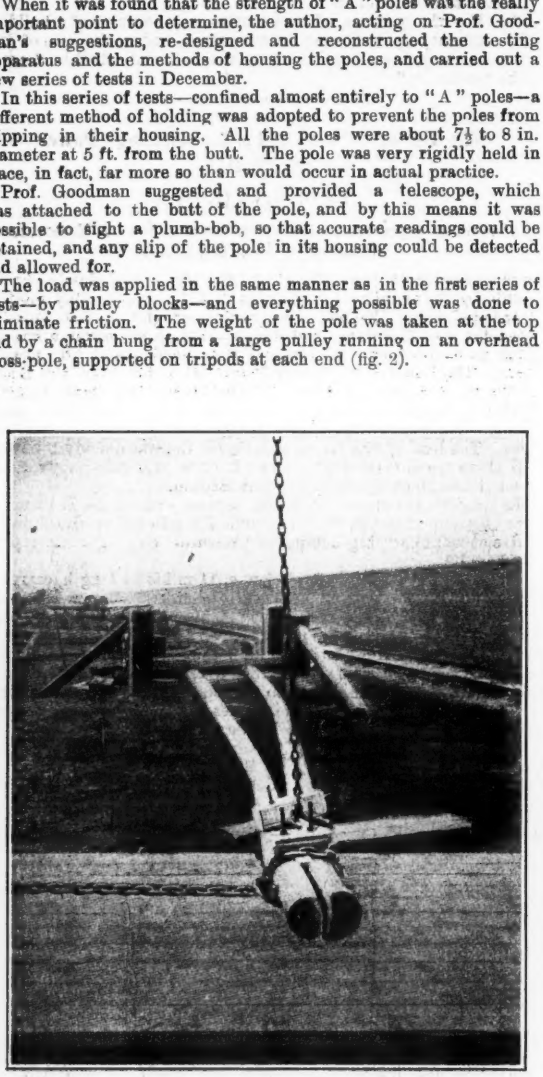


Fig. 2.

In these tests it was found that whereas a single pole would often deflect to a very large extent before breaking, an "A" pole, so long as it held together at the top, would only deflect a few inches. The "A" pole, however, would sustain in a direction across its two members—*i.e.*, at right angles to the line—a load four or five times as great as that of a single pole, of the same diameter as one of the two members of the "A" pole. Also experiments show that an "A" pole is at least twice as strong as a single one of equal section, in the direction of the line, and only deflects half as much.

The "A" poles failed in nearly every instance through the buckling downwards of the member in compression. This was due to the initial sag of this member, caused by its own weight, which it was impossible to allow for. This sag undoubtedly made the poles fail sooner than they would have done had they been in a vertical position, and the results, therefore, are less favourable than they would be in actual practice. But it should be noted that at this point of failure the poles were not actually broken in any way, and if it had not been for the sag out of the line of pull they would undoubtedly have sustained far greater loads. The buckled pole in all cases straightened itself immediately the load was released. In every case the load was applied approximately 2 ft. from the top of the pole, this being about the point where the stress would occur in actual work.

From the tests carried out by the author, it appears that many of the poles in use in this country are misproportioned, and this applies particularly to "A" poles. Some are ridiculously too large, while others are dangerously too small. The few that are correct in length and size have been selected more by luck than judgment. The tests showed that the usual breaking-point of a single pole, when tested to destruction, is about 6 ft. above ground level, or about 10 ft. from the butt. The diameter of a pole at this point is, therefore, the most important dimension to consider in choosing one suitable for certain loads. The top diameter of a pole is also of some little importance, but this is a dimension which Nature settles, and there is no object in altering the natural taper, although the

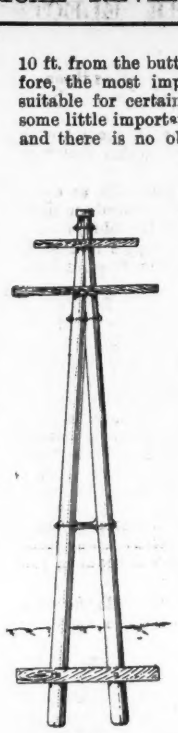


Fig. 3.

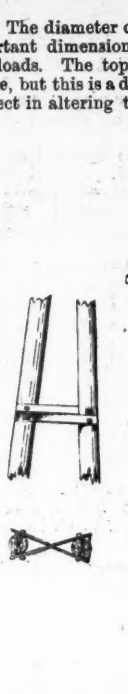


Fig. 4.

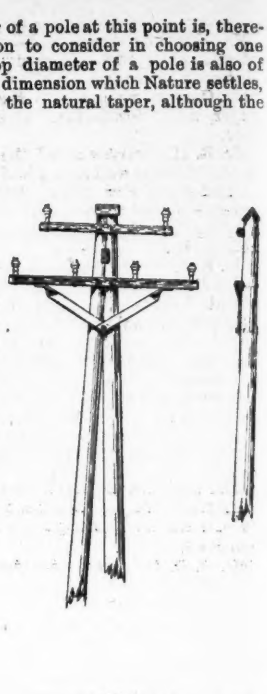


Fig. 5.

author remembers one instance when an inspector visited his works to pass certain poles, and the specified diameter at the top and butt, having been measured with red tape, disagreed with Nature's. The poles were found to be about 1½ in. too large in diameter at the top, and they had to be reduced before being accepted.

The weakest point of an "A" pole is the top, where the stress due to windage and weight takes place. The two members of the pole—owing to their shape—have a tendency to slide and slip on each other when subjected to a load at the top.

The important thing about an "A" pole is its construction and the method adopted to hold its two members at the top. The author's method of securing them is shown in fig. 3. The two members are scarfed to such an extent as to reduce them to about two-thirds of their original diameter. The length of the scarf depends, of course, on the angle at which the members are set. They are held together by two ¾-in. bolts, one about 12 in. and the other about 48 in. from the top of the poles. At the foot the two members are tied together by a wooden block about 6 ft. in length, and 4 in. × 8 in. in section, which is let into and bolted to each about 2 ft. from the butt. The arrangement is similar to that adopted in the tests, which were designed to follow, as closely as possible, the conditions occurring in actual practice.

A centre tie bolt and tubular distance piece is also used between the two members, about 10 ft. above the ground level. Instead of this tie bolt, flat iron plates, fixed diagonally across the poles and bolted to the pole at each end, can also be used with advantage (fig. 4), by which means, undoubtedly, the pole is materially strengthened, and is prevented from twisting. Angles or channels bolted to each side of the pole, across the two members, serve the

Fig. 6.

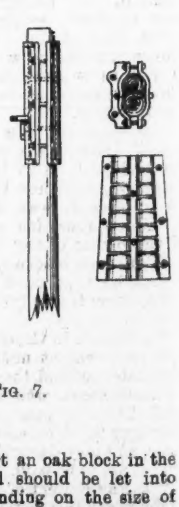


Fig. 7.

same purpose. It is also desirable to insert an oak block in the scarf. This block should be 6 in. deep, and should be let into each member to a depth of about 1 in., depending on the size of the pole used (fig. 5). The tests showed that if the blocks are less in depth, or if they are nearly square, they tend to twist and bed

their corners into the poles, and thus force the members apart. One deep block in the scarf appears to be better than several of less depth, inasmuch as the insertion of several blocks weakens the timber, and if they are fixed high up, they will—when under stress—squeeze the top part of the member on which they bear clean out of the end of the pole. The oak arms let into the poles to carry the insulators materially strengthen the structure and prevent shearing.

The lower insulator arms are sometimes tied to the centre of the pole by flat ties or iron plates, which help to prevent the twisting of the arms and the parting of the two members. The tying together of the ends of the lower and upper arms also helps to strengthen the structure. It is, of course, most important that as little cutting away as possible be done to the poles, especially at the top, as this weakens the timber. Whether insulator arms should be composed of oak or angle or channel iron, seems a very open question, into which the question of insulation and earthing enters very largely. The life and strength of a wooden arm seem to be equal to those of an iron one, if not more, and wooden arms will, no doubt, outlast the pole, and are slightly cheaper than iron.

The author has carried out experiments with different forms of castings designed to hold the two members together at the top, both when scarfed and unscarfed. The poles were placed together side by side and held together at the top by the castings. First (fig. 6) experiments were made with a casting which enveloped the two members of the "A" pole, after scarfing, between the two usual oak arms. This casting was made in halves, held together by three strong bolts passing through them and between the two members of the "A" pole. The casting was so designed that when drawn up tight on the pole the two halves of it did not quite meet,

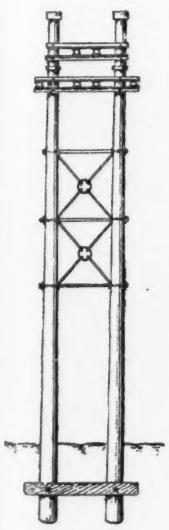


FIG. 8.

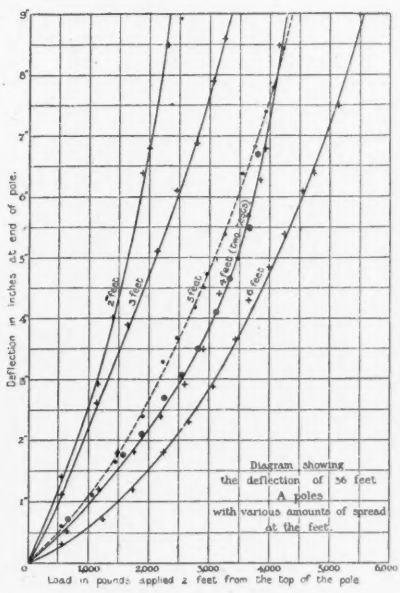

Deflection in inches at end of pole.
Load in pounds applied 2 feet from the top of the pole
Diagram showing the deflection of 36 feet A poles with various amounts of spread at the feet.
2 feet.
3 feet.
4 feet.
5 feet.
4·6 feet (new spread).
6 feet.

FIG. 9.

and at each end of it flanges were formed for the attachment of the two oak arms, these arms being let into the pole to assist in preventing twisting of the members of the pole. The arrangement seemed to hold very well, and only failed in the end through the splitting of the casting.

The second casting was formed to envelop the two members of an "A" pole when tied together at the usual angle (fig. 7) without being scarfed or bored in any way at the top, and it was made in two pieces, as in the previous case, but was bolted together at the edges as well as in the centre. The pole, with one exception, sustained a higher load than any other, and gave a comparatively small deflection, failing in the end through the buckling of the compression member. The slip of the two members on each other at the top was practically nil. In the author's opinion this is the best means of tying the two members together at the top, and would seem to justify the extra cost involved by the more satisfactory results obtained.

Other means of holding the two poles together were also tried.

Tests were also made with "A" poles spread to different widths at the bottom. The spread which gave strength combined with cheapness of erection was found to be about 4 ft. on a 32-ft. pole, or a taper of about 1 in 8, the measurement being made between the centres of the bolts holding the brace which tied the members together near their butts. If a smaller spread than 4 ft. is adopted the poles are not so strong, while a greater spread, though giving some extra strength, increases the cost of excavation and wayleaves.

A favourite form of constructing a double pole is the "H" formation, fig. 8, wherein the two members are erected parallel to each other, and are held together by the arms at the top, being strengthened lower down by cross-bracing, or by tie bolts. Their strength depends, of course, entirely on the method and amount of bracing, and if this is extensively done, they will no doubt be as strong as, if not stronger than, "A" poles of equal size. They have the advantage of presenting a greater surface than an "A" pole to which to attach wires, and are especially useful for terminals of lines for this reason. When used as terminal poles they are stayed with two or four steel rods or wire ropes at the back, to take the stress of the line.

This "H" formation is also extensively used by the leading users of telegraph lines and telephones for main routes, where the poles have to carry a large number of wires, and where a single or "A" pole would not give the requisite surface.

One advantage of wooden poles that the tests have conclusively proved, is their great flexibility and recuperative power after severe deflections from the perpendicular, caused by abnormal stresses.

It is most important in creosoted poles not to cut the treated surface if it can be avoided. Cutting away renders useless the most valuable part of the process, as the oil penetrates chiefly the outside or soft part—which is sapwood—of the timber, and any part which it is found necessary to cut after creosoting should be thoroughly tarred over.

APPENDIX BY PROF. GOODMAN, M.INST.C.E. (*Abstract.*)

SINGLE POLES.

Let—

- W = the breaking load in pounds applied at a point 2 ft. from the top of the pole.
- R = the radius of the pole at the ground level, in inches.
- R_m = the mean of the top and bottom radii of the pole, in inches.
- L = the length of the pole, in inches, measured from the ground level to the point of loading.
- L_o = the overall length, in inches.
- G = the length of the pole, in inches, embedded in the ground.
- T = the distance in inches, from the top of the pole to the point of loading in the actual pole tested.
- S = the "spread" or "splay" of an "A" pole at the bottom, in inches.
- f = the "modulus of rupture" for the pole in lb. per sq. in.
- K = the Post Office constant for comparing similar beams $= \frac{f}{6}$.
- d = the elastic deflection, in inches, under a load of 1,000 lb. applied at the extreme end of a unit pole 12 in. long, 1 in. diameter, and of the same taper and material as the tested pole.
- D = the elastic deflection, in inches, at the point of loading of the actual pole when tested.
- E = Young's modulus of elasticity for timber, in lb. per sq. in.
- d_w = the diameter, in inches, of each wire or cable supported by the poles.
- L_s = the length of span of the wires in feet, *i.e.*, the distance from pole to pole.

When the pole is truly circular in section we have—

$$K = \frac{W L}{4{\cdot}7\ R^3}.$$

The value of K is obtained from a breaking test of a pole; then the breaking load of any other similar pole is given by—

$$W = \frac{4{\cdot}7\ R^3 K}{L} \quad \text{for a pole of circular section.}$$

The value of d is found by experiment on a pole.

To calculate the deflection of any other pole of similar material and taper we have—

$$D = \frac{W L^3 d}{27{,}648{,}000\ R^4} \quad \text{for a pole of circular section.}$$

WIND PRESSURE.

The chief lateral stresses to which telegraph and overhead transmission poles are subjected are due to wind pressure acting on the wires and on the poles themselves. The wind pressure assumed by the Board of Trade for high-voltage overhead transmission work is 30 lb. per sq. ft., the wind acting normally to a flat surface; in the case of a cylindrical surface, such as a wire or pole, the resistance to the wind is only 0·5 to 0·66 of that on a flat surface; for the wires we shall assume the higher value, viz., 0·66, and the lower value for the poles, mainly because it is well known that the pressure of the wind diminishes as we approach the ground.

The wind pressure on one wire is, on these assumptions, $1{\cdot}67\ d_w L_s$.

The wind pressure on a pole is $\frac{R_m (L_o - G)}{4{\cdot}8}$.

The resultant of this pressure acts at a point approximately halfway up the pole, hence the equivalent pressure acting at a point 2 ft. from the top of the pole, *i.e.*, where the resultant pressure due to the wind on the wires is assumed to act, is—

$$\frac{R_m (L_o - G)}{4{\cdot}8} \times \frac{(L_o - G)}{2L} = \frac{R_m (L_o - G)^2}{9{\cdot}6 L}.$$

Hence the net safe load for a pole, *i.e.*, the safe load it will support in the shape of wind pressure on the wires, is, for a factor of safety of 10—

$$\frac{4{\cdot}7\ R^3\ K}{10\ (L_o - G - T)} - \frac{R_m\ (L_o - G)^2}{9{\cdot}6\ (L_o - G - T)} \left\{ \text{for a pole of circular section.} \right.$$

"A" POLES.

The theoretical treatment of single poles is a tolerably simple matter, and can be relied upon within narrow limits, but we cannot say the same with regard to "A" poles, as there are so many uncertain factors.

When an "A" structure is loaded, the one leg is subjected to tension and the other to compression, the force in each being $\frac{W\ L}{S}$; the structure may therefore fail by tearing apart the tension pole, by buckling the compression pole, or by shearing the apex joint. With the exception of one faulty pole, none of the "A" poles tested failed in tension; several, however, failed by shearing at the top joint. This source of weakness was overcome by adopting an improved joint, which was the outcome of these tests, and details of which are given in the body of Mr. Wade's paper. Most of the poles failed when under test through the buckling of the compression pole.

If the pole were rigidly held at both ends, its equivalent length would be one-half its actual length. The tests appear to show that, owing to the central stay and the scarfing of the joint, this is about the equivalent length of the compression member of an "A" pole.

For practical purposes, it is convenient to use the same expression for "A" poles as for single poles; for "A" poles loaded either in their own plane, *i.e.*, at right angles to the wires, or in the direction of the wires (but, of course, the values of K_A will not be the same in both cases), this becomes, when the poles are circular in section—

$$K_A = \frac{W\ L}{2{\cdot}35\ (R_A^3 + R^3)}.$$

A comparison of the values K_A and K gives the relative strengths of an "A" pole and a single pole of the same size as one of the "A" poles. Whence—

$$W = \frac{2{\cdot}35\ K_A\ (R_A^3 + R^3)}{L}.$$

Experiments show that $K_A = 4{\cdot}5\ K$ for poles in which the ratio $\frac{L}{S} = 8$ (see tables). Then $K_A = 5{,}860$ lb. per sq. in.

DEFLECTION OF "A" POLES.

For practical purposes it is convenient to make use of the same form of expression as for comparing the relative deflections of single poles, viz.:—

$$D_A = \frac{W\ L^3\ d_A}{13{,}824{,}000\ (R_A^4 + R_a^4)} \left\{ \text{when both poles are circular in section and of radii } R_A \text{ and } R_a. \right.$$

The quantity d_A is the deflection of a unit "A" pole 12 in. long, 1 in. diameter when loaded with 1,000 lb. at its extreme end, and is obtained from experiments on "A" poles, as explained above for single poles.

When "A" poles are loaded in the direction of the wires, the strength of the structure is twice that of a single pole of the same dimensions and material, and the deflection is one-half as great.

WIND PRESSURE ON "A" POLES.

When the wind is blowing transversely to the wires the one leg of the "A" pole partly shelters the other, it is not easy to say exactly to what extent. We have assumed the wind pressure to be 1·5 times as great as on a single pole of the same size as one of the "A" poles. Hence the resultant wind pressure acting at a point 2 ft. from the top of the pole, where the poles are both circular, and the radius of the one is R_A and the other R_a, is—

$$\frac{(R_A + R_a)\ (L_o - G)^2}{12{\cdot}8\ L}.$$

The net safe load in pounds for an "A" pole, *i.e.*, the safe load it will support in the shape of side wind pressure on the wires, is, for a factor of safety of 10, and when the poles are both circular and of the same size,—

$$\frac{4{\cdot}7\ K_A\ R^3}{10\ (L_o - G - T)} - \frac{R_m\ (L_o - G)^2}{6{\cdot}4\ (L_o - G - T)}.$$

Some of the results of the tests are given below.

From the results we find that the mean value of d for single poles is 8·4 in., and for "A" poles tested on the flat 4·3 in.; thus the deflection of similar "A" poles when tested on the flat is practically one-half as great as that of a single pole when similarly loaded, which is quite what we should expect.

Taking an average value for such poles as are likely to be used in practice, tested edgeways when properly held at the foot, we find that $d = 0{\cdot}17$ in., or $\frac{1}{50}$th as much as that of a single pole.

As regards the relative strength of single and "A" poles, the mean value of K_A, as deduced from poles of practical design, is 5,748 lb., or 4·42 times as great as the Post Office value for a single pole. As already pointed out, the majority of poles failed through the buckling of the compression leg; this buckling was undoubtedly hastened by the initial sag in the poles due to their own weight, which, of course, will not occur in practice where the poles are set in a vertical position, hence it is considered safe to assume that "A" poles are about 4½ times as strong as single poles of the same size.

DISCUSSION.

Prof. GOODMAN, who was invited to open the discussion, remarked that the wind load was the important factor in designing pole lines. The B. of T. rules of 30 lb. per sq. ft. wind pressure, and a factor of safety of 10, were justified in the early days, but in the light of recent tests he considered these figures might be reduced. Sir John Wolfe Barry had mentioned that he never recorded as much as 5 lb. per sq. ft. wind pressure on the Tower Bridge, although 40 lb. had been recorded on the exposed Forth Bridge; so that 10 lb. per sq. ft. wind pressure appeared to be a reasonable figure for inland lines, and the factor of safety might also be reduced. He had only discovered two or three isolated instances of poles breaking, although scores were uprooted, which pointed to the necessity of good foundations. The compression pole always gave way by buckling, but could be stayed. He noted in passing that the central ring in the bracing of "H" poles was very bad designing; also that the cutting of the line wires would throw nearly twice as much stress on the poles as the wind pressure at 30 lb. per sq. ft.

Major O'MEARA contested the author's statement that there were no reliable data as to pole lines, and referred to P.O. publications on the subject. He pointed out that single poles carried some 60 or 70 wires; that the greatest enemy to pole construction was fine snow; that "A" poles had been used; and that he had never seen a pole broken. The P.O. factor of safety was only 4; they had had poles which lasted as long as 40 years, though, on the average, he considered the life was much less than that.

Mr. A. P. TROTTER remarked that P.O. practice ended where transmission work began, the latter being much heavier, and under more severe conditions. There were 60 miles of such transmission

TESTS OF WOODEN POLES.

Index.	Splay at foot of pole in inches S.	Overall length of pole in inches L_o.	G. Inches.	L. Inches.	T. Inches.	Radius at ground level in inches. R_1.	Radius at ground level in inches. R_2.	Breaking load in pounds. W.	Breaking load in pounds. K.	Elastic deflection in inches under a load of 1,000 lb. D_c.	Elastic deflection in inches under a load of 1,000 lb. D.	d. Inches.	Remarks.
a	—	476	64	386	26	5·6	5·4	Approximate 2,200	1,100	20·00	18·20	8·30	Unseasoned Swedish fir, not creosoted. — Single poles.
c	—	478	64	387	27	5·2	5·5	1,860	1,030	30·00	27·20	10·00	Unseasoned Russian fir, creosoted. — Single poles.
d	—	444	70	351	23	5·2	4·7	Approximate 2,480	1,457	17·00	15·50	7·20	Seasoned Swedish fir, not creosoted. — Single poles.
c_1	25	384	64	291	29	5·4	5·5	Not broken		2·97	2·58	2·58	Russian fir. See fig. 3. Three oak chocks in apex. — Imperfect method of holding foot of pole.
						5·5	5·5	Max. load 3,430					
f	25	385	64	295	26	4·4	4·6	Not broken		8·20	7·10	3·00	Swedish fir. See fig. 3. No chocks. — Imperfect method of holding foot of pole.
						4·4	4·7	Max. load 3,220					
i	48	433	43	370	20	3·7	3·8	4,160	5,496	0·95	0·88	0·11	See fig. 5. Two chocks. Failed by buckling the compression pole. — "A" poles tested on edge, *i.e.*, at right angles to the wires.
						4·1	4·0						
k	60	434	46	369	19	4·0	4·2	5,400	7,192	1·10	1·02	0·14	See fig. 5. One chock. Failed by crushing and rotation of the oak chock. — "A" poles tested on edge, *i.e.*, at right angles to the wires.
						3·7	3·7						
m	48	432	46	362	24	4·0	3·9	3,800	4,870	0·55	0·50	0·069	Casting bolted to the top end of the poles. Failed by the buckling of the compression pole. See fig. 6. — "A" poles tested on edge, *i.e.*, at right angles to the wires.
						3·9	3·8						
c_2	25	384	46	314	24	5·4	5·5	5,700	2,315	0·50	0·45	0·36	Same as c_1. Failed by twisting oak chocks. — "A" poles tested on edge, *i.e.*, at right angles to the wires.
						5·5	5·6						
e_4	25	384	64	291	29	5·5	5·4	Not broken		4·20	3·60	3·70	Same as c_1. — "A" poles tested on the flat, or in the line of the wires.
						5·5	5·5	Max. load 3,900					
f_2	25	385	64	295	26	4·6	4·4	Not broken		11·70	10·20	4·90	Same as *f*. — "A" poles tested on the flat, or in the line of the wires.
						4·7	4·4	Max. load 3,070					

lines in Britain, and he noted that they had weathered last winter without mishap. Certain pole lines had been designed for a wind pressure of 50 lb. and a factor of safety of 12, under a misapprehension, but not during the past two years. He pointed out that the irregular character of timber precluded the using of a smaller factor of safety than 10, which latter was a recognised one for timber structures; also that the P.O. factor took into account other factors. Creosoting by a modern process would, he believed, lead to a longer life. In considering pole designs, the B. of T. usually treated individual cases on their merits. From an economical point of view, two smaller poles built into "A" shape were best for heavy transmission work.

Mr. Frank Gill remarked that the compression tests given by the author were very valuable. His company frequently carried 100 telephone wires on a single 70-ft. pole, and single poles were much handier in many ways, particularly as regards wayleaves. He thought that Continental poles were lighter than ours; and that single poles, stayed, had better foundation-holding power than "A" poles. In regard to the best type of pole to use, he had assumed a certain stress, and calculated that, taking a 30-ft. 7-in. diameter pole, and comparing the costs for "A" and single-stay poles, the capital costs in the two cases were as 100 to 55, and the annual costs as 100 to 73. Similarly, taking "A" and double-stay poles, the capital costs were as 100 to 80, and the annual costs were equal; the two examples were equal in strength across the line, but the single pole was stronger along the line. He thought the economy of the "A" pole was not quite clear.

Mr. C. H. Chamen (Lancashire Electrical Power Co.) pointed out that the mains engineer wanted small poles, which could be easily moved and erected. It was quite possible to lose a consumer while negotiating with the B. of T. as to the type of pole to adopt, and there were many temporary jobs which could be connected, if this could be done quickly. The "A" type pole was used because the land owner would not have stays. He thought light poles were absolutely necessary if overhead transmission has to pay, and pointed out that the extra poles and cradling at road crossings entailed serious expense.

Another speaker referred to the difficulty of meeting the requirements of the numerous authorities and interested parties when locating a pole. He deprecated the cutting about of the tops of poles, and remarked that the most economical design of "A" pole required a ratio of 8 to 1 for height of pole to spacing at bottom.

Mr. W. A. Chamen (South Wales Electric Power Distribution Co.) remarked that as transmission engineers were not allowed on public roads, the single pole was not preferable to the "A" type on that account. He considered that some far too heavy pole lines had been put down, and that lighter poles would enormously reduce the costs. Notching and cutting of poles would impair their life considerably, and it would be better to adopt standard forms, and to machine the poles before they were creosoted.

Mr. John Gavey referred to the question of creosoting; he had had to renew creosoted poles in 10 years, and thought it probable that the better creosote in the old days might compensate for the lack of a good creosoting process then. If an "A" pole failed, it was generally due to bad foundations, and you could not get such a foundation as would allow of pole fracture by ordinary working stress; further, you could not localise the decay in a creosoted pole as in an untreated pole.

Mr. Wade, who reserved his reply, pointed out that his tests related to "A" type poles, which had not been dealt with by the P.O.

LEGAL.

Thorpe *v.* E. L. Berry, Harrison & Co.

We have received the following report:—

After protracted litigation, a question of considerable interest to electrical engineers and to gas and electricity supply companies has been finally solved by His Honour Judge Woodfall and a jury at Westminster County Court on May 13th.

Messrs. E. L. Berry, Harrison & Co., electrical engineers, of Lyric Chambers, Whitcomb Street, W.C., as far back as June 28th, 1906, were sued by Leonard John Thorpe, the steward of Dryden Chambers, Oxford Street, for damages sustained through the alleged negligence of the defendant firm or their servants, in that they being electrical engineers did negligently permit or suffer the door flap or covering of the cellar of the lodge at Dryden Chambers to be left open on March 19th, 1906, without any protection or warning, whilst they or their servants were working therein, in consequence of which it was alleged the plaintiff fell into the said cellar and was injured. The plaintiff claimed £50. The defendant company affirmed that their electrician under contract and for a nominal fee was sent quarterly to test the electric mains. That the porter at the lodge was in control, and opened the trap door. They took no responsibility whatever, the porter (a fellow servant of the plaintiff) being in fault in leaving the lodge whilst the trap door was open. On this, the first trial in the County Court, the jury found against the defendant firm, and awarded the plaintiff £20 damages.

Shortly afterwards on July 11th, 1906, upon motion, His Honour ordered a new trial upon the ground that the verdict of the jury was against the weight of evidence.

The case was re-heard upon July 27th, 1906, and the jury found that the defendant firm were not responsible for the safe keeping of the trap door, that they took reasonable care in the performance of their work, and that the accident was due to the joint neglect of the defendant's electrician and the porter. Upon these findings, and on the defendant firm's motion, His Honour gave them judgment.

Against His Honour's decision the plaintiff appealed, and on March 18th, 1907, the Divisional Court, consisting of Justices Darling and A. T. Lawrence, ordered a new trial, an order which was confirmed by the Court of Appeal.

On May 13th, 1907, the case came on for hearing for the third time before His Honour Judge Woodfall and a jury, and, after occupying the whole day, the jury found for the defendant firm, and His Honour directed judgment to be entered accordingly, intimating that he considered the case of very considerable importance to contractors, and in consequence he made a special order as to the costs which followed the event.

The plaintiff was represented by Mr. Poyser, instructed by Messrs. Stoddart and Bannerman, and the defendant firm by Mr. Herbert Nield, M.P., instructed by Messrs. Maffey and Brentnall.

PARLIAMENTARY.

Electric Lighting Provisional Orders (No. 1) **Bill.**—This Bill came on Monday before the Unopposed Committee of the House of Lords and was ordered to go forward for third reading. The Bill confirms provisional orders granted in respect to Aston Manor, Chesham, Hipperholme, Lytham, Newark, Penrith, Pontefract, and Stockport.

West Ham Corporation Tramways.—The Great Eastern Railway Co. have given notice of their intention to oppose the West Ham Corporation Tramway Order contained in the Tramways Orders Confirmation Bill.

Electric Supply Corporation, Ltd.—On Monday the Bill promoted by the Electric Supply Corporation, Ltd., came before Lord Onslow's Committee of the House of Lords on Unopposed Bills. The object of the Bill is to transfer to the company electric lighting orders relating to Exmouth, Hitchin, Sidmouth, Stevenage, Dawlish, Hendon, Tynemouth, Dollar, Jedburgh, Totnes, Dalkeith, and Melrose. Mr. Marriott gave formal evidence in support of the preamble, and the Bill was ordered to go forward for third reading.

Central London Railway Bill.—This Bill came before the Unopposed Bill Committee of the House of Commons on Thursday, May 30th. Mr. Pritt (Parliamentary agent) stated that all that was asked was for authority to make certain works at the Shepherd's Bush terminus. There was no application for fresh capital. Formal evidence was given by Sir H. Oakley, and the preamble of the Bill was passed.

Tramway Orders Confirmation Bill.—The examiner of the House of Lords last week found the standing orders complied with in the case of the above Bill, which confirms the following Board of Trade Orders:—

Audenshaw.—Order authorising the Audenshaw U.D.C., in the county of Lancaster, to construct the tramway in their district authorised by the Audenshaw U.D. Tramway Order of 1899.

Huddersfield.—Order authorising the Huddersfield Corporation to construct an additional tramway in the borough. The line is nearly a mile in length.

Leeds.—Order authorising the Leeds Corporation to construct additional tramways. Three tramways are scheduled, of a total length of about 2½ miles.

Taunton.—Order to the Taunton Electric Traction Co., Ltd., for the construction of an additional half mile of tramway in the borough.

West Ham.—Order to the Corporation to construct nine tramways in the borough, most of which are small junction lines. No. 2 tramway is over a mile long.

London County Council (General Powers) Bill.—On Friday last this Bill was before the House of Commons' Committee, and it was explained that the Council had powers to improve the approach to the Houses of Parliament by constructing a new road, which involved the removal of the generating station of the Westminster Electric Supply Corporation. The Council sought an extension of time to carry out the work, till August, 1909, which was opposed by the company. Evidence was given to the effect that the Council was not to blame for the delay in the reinstatement of the company's plant on a new site in Horseferry Road, and Mr. J. H. Rider, electrical engineer to the Council, said the new generating station could be ready within two years.

London County Council Electric Supply Bill.—Messrs. W. Howell Davies, Jos. Nolan, W. W. Rutherford, D. A. Thomas and Sir Albert Spicer, have been nominated by the House, members of the Select Committee on the London County Council Electric Supply Bill; and the following have been nominated by the Committee of Selection, Mr. A. E. Dunn, Sir Philip Muntz, Mr. John Ward and Major Renton.

Taunton Tramways.—The National Telephone Co. have deposited a petition praying to be heard against the confirmation of the Taunton Tramways Extension Order.

Cooling Towers.—Among the orders recently received by Messrs. Jarvis Bros., Ltd., of Middlesbrough, for their patent "British" cooling towers are the following:—

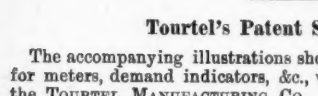
Bolton Corporation Electricity Works, Bolton, (2 repeat orders).
Isle of Thanet Electric Tramways and Lighting Co., St. Peters, Kent.

A new four-page illustrated pamphlet has just been issued describing the construction, &c., of these towers.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Tourtel's Patent Seal Padlock.

The accompanying illustrations show a new patent seal padlock for meters, demand indicators, &c., which is being introduced by the Tourtel Manufacturing Co., Ltd., of 57, Chiswell Street, E.C. As may be seen, the seal is effected by means of a printed slip of paper, which is slipped in place over the keyhole before the lock is closed. It is stated to be impossible to tamper with it



Lock Open.

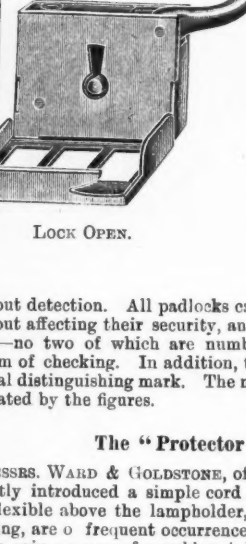
Lock Closed, with Paper Seal over Keyhole.

without detection. All padlocks can be opened with the same key, without affecting their security, and the method of numbering the seals—no two of which are numbered alike—affords a complete system of checking. In addition, the paper may, of course, bear a special distinguishing mark. The method of operation is sufficiently indicated by the figures.

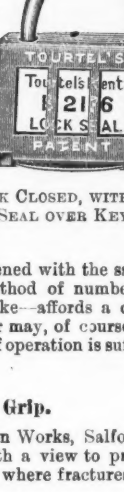
The "Protector" Cord Grip.

Messrs. Ward & Goldstone, of Sampson Works, Salford, have recently introduced a simple cord grip, with a view to protecting the flexible above the lampholder, a place where fractures, due to bending, are o frequent occurrence.

The grip consists of a rubber tube or sleeve A, slightly taper in



Sectional View shewing Cord Grip in Position.



Cord Grip and Metal Washer.

shape and having a flange at the lower end. A metal washer B, having two side pieces or tongues, is slipped over the tube and serves to compress it when the cap of the lampholder is screwed down. Our illustrations explain the device clearly; it is inexpensive and worth trying.

Meeting of Creditors.—Messrs. Jones, Evershed & Co., Ltd., electro-metallurgists, Barlow Mow Lane, Canton, Cardiff.—This company has ceased trading, and a meeting of creditors was called for the 5th inst. to explain the position and make an offer of composition. The liabilities are £2,008 and there is a deficiency of £1,746.

BUSINESS NOTES.

Foreign Markets.—Cuba.—*The Chamber of Commerce Journal*, in its current issue, says that people in this country fail to appreciate the value of the Cuban market. They really seem to imagine that Cuba is merely an insignificant island "where the cigars come from," and the trade of which is not worthy their attention. "A greater mistake was never made. Its external trade last year reached a value of more than 40 millions sterling, and it must be borne in mind that Cuba is not a manufacturing country, but has to import practically all her requirements. It is true that American goods enter the island at a lower rate of duty than those of other countries, but that is no reason why British manufacturers, with a little care and attention, should not compete successfully. But it is absolutely necessary that every effort should be made to supply exactly the kind of goods required to suit the market, and then to ensure the prompt execution of orders. . . . The best means of introducing British goods into Cuba would be for several firms to combine to establish a small sample depôt in Havana, and our honorary correspondent in that city, who is at present in London, would be pleased to give any information on this and other points to firms wishing to cater for the great and increasing demands of the Cuban market."

Sweden.—The same journal, in referring to the question of British trade with Sweden, says:—"Our honorary correspondent at Stockholm calls attention to the importance of the Swedish market, and is convinced that, if British firms would send out agents and travellers, as is done by their American and German competitors, they would secure a good share of the trade of the country. It is important, however, that travellers should know the language and understand the people. Surely, he says, if it is worth while for America and Germany to go to the expense of sending travellers to Sweden, it should pay British firms to be represented in a number of articles. In these days it is useless to expect any great results from an indiscriminate dispatch of circulars. To secure orders, a first-class traveller is essential, especially in foreign countries, where education ranks so high amongst the commercial community. A few years ago a small number of English commercial travellers visited Sweden, but hardly any are now to be found there. British manufacturers appear to content themselves with sending circulars, and, in some cases, appointing buying agents, who frequently push the goods of other countries, if found to be profitable, and lock up the business for the English firms. Other countries, even if they have an agent, send a traveller to see that the agent is properly working his district. Our correspondent adds that: 'It has now come to this. When an agency for an English house is offered to a Swede, he accepts it if he thinks it will prevent competition—that is to say, he locks it up. Of course, this does not mean that people are not to be found who will work if it is worth while, and work hard if properly looked after. In a number of branches English firms could do a good trade in Sweden if they took a little trouble in the matter.'" These comments form a striking endorsement of much that was said in the article on "Our Foreign Electrical Trade" in the Electrical Review of last week.

Amendment of Patent.—Notice is given in our advertisement columns to-day of the proposed amendment of patents relating to incandescent lamp manufacture.

Refuse Destructor Profits.—According to the local Press, the Blackpool Cleansing Department during the past year has spent over £800 less than was expected, while the revenue is £500 in excess of the estimates, thanks mainly to the receipts from the sale of mortar and other by-products from the refuse destructor, which was erected by the Horsfall Destructor Co., Ltd., in 1904.

Book Notices.—*The Handelshochschule.* Berlin: H. S. Hermann. 1907.—This is a little pamphlet presented to "the British editors" on their visit to Berlin last month; it describes the commercial university founded by the Berlin Merchants' Corporation for the training of students who have gone through a regular apprenticeship, and have acquired a reasonable degree of general training. The school was opened on October 27th last year, and during the first semester there were no fewer than 1,371 students and others attending the lectures, a number since increased. No English-speaking students have as yet been enrolled. The fee to Germans for the whole curriculum is 125 M. per semester; to foreigners it is 250 M. The courses are laid out apparently with a view to quick returns, if not small profit, for the approved course covers only two years.

"Garden Making." By E. O. Greening. London: Agricultural and Horticultural Association, Ltd. 1d.

"Science Abstracts." Sections A and B. Vol. X, part 5. May, 1907. London: E. and F. N. Spon, Ltd. 1s. 6d. net each part.

"Fire Tests with Floors." (Reinforced brick and concrete, Eggert girderless system). Report of the British Fire Prevention Committee. From the Committee, 1, Waterloo Place, S.W. 2s. 6d.

"British Standard Specifications," No. 29.—Ingot Steel Forgings for Marine Purposes; No. 32, Steel Bars for use in Automatic Machines. London: Crosby Lockwood & Son. 2s. 6d. net each.

Messrs. William Collins, Sons & Co., Ltd., of Bridewell Place, New Bridge Street, E.C., have sent us sample copies of "Collins' 'Handy' Modern Fiction," described as the greatest revolution ever witnessed in the book world. And indeed, it is a marvellous thing that these dainty little volumes can be produced, printed in clear type on good paper, with coloured frontispiece, and neatly bound in cloth, with gold lettering, for the sum of 7d. each. The books are by well-known authors, such as Maxwell

Gray, Besant and Rice, and others, a long list, we understand, being on the way. We can safely recommend this series to our readers.

Trade Announcements.—The Union Electric Co., Ltd., announce that their office for Scotland is now at 12, Waterloo Street, Glasgow, where their telephone numbers are "1910 Argyle" and "2048 Central" (Post Office).

Messrs. Hunt & Hess, of Litholite Works, The Grove, Hackney, N.E., announce that the expansion of their business has led to the formation of the company styled "Litholite, Limited."

Messrs. Tamplin & Makovski, Ltd., electrical engineers, have opened new business premises in Bell Street, Reigate.

Messrs. Newtons, Ltd., Taunton, inform us that they have appointed Mr. J. Lawson, of 35, Mount Stuart Square, Cardiff (telegraphic address "Potential, Cardiff," Nat. Telephone No. 01017) as their agent in South Wales. He will keep a stock of motors at his address ready for immediate delivery. Inquiries may be addressed either to him or to the firm.

Messrs. A. Keartland & Co., electrical engineers, Arcade Balcony, Walsall, have purchased the business of Mr. H. Curtis, Birchills Street, Walsall.

The business of the Improved Electric Supplies has been taken over from May 17th, 1907, by Messrs. Laing, Wharton and Cunnington, who will be responsible for all payments.

Messrs. Robinson & Jones, 21, Collingwood Street, Newcastle-on-Tyne, announce that they have relinquished their agency for the Brush Electrical Engineering Co., and have been appointed representatives for the North of England for Messrs. Brown, Boveri and Co., Ltd.

Catalogues and Lists.—Messrs. The Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, E.C.—Card illustration of the latest type of Sturtevant Electric "Propeller" ventilating fan, driven by totally-enclosed dust-proof motor—further described in Sectional Catalogue, No. 38.

Messrs. Rolls-Royce, Ltd., 14 and 15, Conduit Street, W.—New catalogue of the all-British 40-50-h.p. six-cylinder Rolls-Royce motor-car, beautifully got up, and setting forth the victories, merits, and special constructional features of this well-known automobile, with illustrations.

I.T.E. Electric Co., Ltd., 20, Great Russell Street, London.—16-page publication, containing a full description with large illustrations of their "Dal-ite" direct acting limit inverse time element circuit-breaker.

Messrs. De Dion, Bouton (1907), Ltd., 10, Great Marlborough Street, W.—Catalogue of "De Dion, Bouton Motor Combination," showing direct-coupled petrol engine, electric generating pump and belt pulley sets. The petrol-electric sets are provided with electric governors giving constant voltage, and are made for permanent installation, portable or for traction on rails. The catalogue is mainly devoted to the electric sets, and is fully illustrated.

Messrs. Archibald J. Wright, Ltd., Leyton Green Road, N.E.—May illustrated price list of automobile accessories and electrical instruments, including batteries, sparking plugs, ignition coils, charging dynamos, measuring instruments, &c.

Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.—Card requesting the return of "Weston" instruments in need of re-calibration or repair, to the firm's London Laboratory at the above address.

Messrs. The Hart Accumulator Co., Ltd., Stratford, E.—Folder describing the firm's special cell-testing voltmeters, graduated in tenths and reading to 3 volts either way.

Messrs. G. Braulik, 217 and 218, Upper Thames Street, E.C.—List of porcelain and iron watertight fittings, specially prepared for use where security from earth and damp are necessary. Also list of arc lamp couplings and winches, which are different from any others on the market.

Dr. Heinr. Traun & Sons, London Agency, 8, Redcross Street, E.C.—New price list of ebonite (vulcanite) sheets, rods and tubes, with a leaflet calling attention to the importance of taking account of the specific gravity of the material, which in cheap and inferior samples may be heavily loaded with foreign matter.

The Union Electric Co., Ltd.—This company, whose headquarters are at Park Street, Southwark, S.E., has just removed its Northern Districts Office at Newcastle-upon-Tyne, the present address being 50, Grainger Street. It is about three years since the local branch was established, and the business extended so much in that period that it became imperative that a move should be made; the present premises, at once centrally situated and convenient, were secured, to be used as local offices and a suitable place where the leading types of the firm's manufacture can be seen. The northern section of the firm's business has extended most markedly in two branches—the supply of high-power arc lamps (particularly the Excello lamp) and the supply of mining fittings. The firm has received orders for some specially constructed inverted lamps for some of the extensions at the great Elswick yard, the lamps having met with much favour in the constructive section of the works because of their shadowless light. To mark the change of premises, the Union Electric Co. entertained a number of friends to dinner on the 30th ult. Mr. James Gilman, district manager, presided, and amongst others present were Mr. Justus Eck, chief engineer to the company, Messrs. J. L. Glendinning, T. Campbell Futers, J. H. C. Brooking, R. Robson, T. Rook, and many others. The Chairman proposed the toast of "Our Guests," which was replied to by Mr. Robson, Mr. Brooking, and Mr. Glendinning, who proposed the toast of the "Union Electric Co.," to which also several other guests spoke, referring appreciatively to their dealings with the company. Music was provided, and a most enjoyable evening was spent.

Liquidations.—Phodyne Electrical Co., Ltd.—At a meeting held on the 24th ult. a resolution was confirmed that the company be wound up voluntarily, and that Mr. A. W. Langley, secretary, be appointed the liquidator.

Morris Hawkins Electrical Co., Ltd.—At a meeting held on April 30th, it was resolved that the company should be wound up voluntarily, and that Mr. E. I. Husey, of 56, Coleman Street, London, be appointed the liquidator.

Electrical Improvements, Ltd.—A resolution that the company should be voluntarily wound up, with Mr. I. Robinson, 44, Parliament Street, Nottingham, as liquidator, was confirmed on the 9th ult.

The Tournament at Olympia.—The lighting outside the main entrance to Olympia on the occasion of the recent Royal Naval and Military Tournament was carried out by the use of the "Ediswan Carbone" flame arcs, to which we recently referred at some length in these pages. We understand that if specially required, these lamps can now be sent out with impregnated carbons, which add considerably to their light, and render them specially useful for large open spaces, pit-heads, goods yards, sidings, and other places where a brilliant light is required, and the yellow flame not a matter for objection. The whole of the fittings in the royal box, ante-room, and passages at Olympia for this tournament, were supplied for the occasion by the Edison and Swan United Electric Light Co., Ltd., of Queen Street, E.C.

Bankruptcy Proceedings.—J. D. Gibbs.—Under a receiving order made recently in the London Bankruptcy Court against John Dixon Gibbs, described as of 1, Linden Gardens, Bayswater, the first meeting of creditors was held on Wednesday last week before Mr. G. W. Chapman, official receiver. The matter was briefly mentioned in our "Notes" last week. It was stated that the statement of affairs showed liabilities £13,990, and assets of uncertain value. They consist chiefly of a commission note relating to the placing of shares of the International Electric Railways and Water Power Syndicate, Ltd., and a similar note in connection with the formation of a company to take over certain copper mines in the Caucasus. The debtor anticipates receiving sufficient funds from these notes to enable him to pay his debts in full. He states that he has been connected with electrical undertakings in the country for many years, and more especially with the transforming system, which he patented in conjunction with Mr. Gaulard. His dealings in electrical undertakings date from 1881, and the immediate cause of his failure was a decision of the House of Lords in 1890, which held that his patent had been anticipated by a Russian subject named Jablochkoff. The debtor also explained his appearance in the Court by the action of his bankers in stopping his credit in 1903. The debtor asked for an adjournment of the meeting in order that negotiations which were pending with a view to the realisation of the commission notes might be matured and the creditors benefited thereby. The petitioning creditor objected on the ground that there had already been undue delay, but the chairman took the view that an adjournment would not harm the estate, and that an adjudication in bankruptcy might prejudice the prospects of the creditors. The meeting was adjourned for four months.

K. C. Moran & Co.—At Walsall Bankruptcy Court on May 30th, Kevin Cuthbert Moran, trading as K. C. Moran & Co., electrical engineers, 80a, Teddesley Street, Walsall, and 30, High Street, Coventry, was examined. The accounts showed liabilities amounting to £235 1s. 10d., and a deficiency of £176 8s. 1d. Debtor stated that he did not think he could file an account showing his losses at Coventry. He attributed his failure principally to loss on the Coventry business and keen competition. The debtor was directed to file a cash account, and for this purpose the examination was closed.

E. C. Holt (Holt & Co.), electrical engineer, Rhyl.—Notice is given of the intended payment, on the 17th inst., of a composition of 10s. in the pound.

For Sale.—A quantity of electrical apparatus (motors, dynamos, lamps, instruments, &c.). See our advertisement pages to-day.

LIGHTING and POWER NOTES.

Aston.—During the past year the gross profit on the E.L. undertaking amounted to £6,612, as against £4,692 in 1905-6; the net profits were £762 and £668 respectively.

Burnley.—The annual report of the electricity undertaking shows that the total units sold were 2,954,608, against 2,693,940 last year. The net profit, after providing £5,585 for interest and sinking fund, amounted to £5,384, against £5,190 in the previous year. The profit is to be disposed of as follows: Relief of rates, £3,015; depreciation fund, £2,369. The total costs, with the exception of extraordinary expenditure, were ·759d. per unit, against ·727d. last year. This increase is largely due to the increased cost of coal. The engineer reports that the present generating plant will hardly be sufficient to provide for emergencies arising on the traction or lighting system. With the rapid increase in the day load (motor users), there is a possibility of the highest peak of the total load occurring at 5 p.m. in mid-winter, or half an hour before the bulk of the motors are switched off.

Blackpool.—The accounts for the past year's working of the electricity department show a revenue amounting to £35,291; working expenses, £15,389; and after meeting financial charges, a balance of £8,229. Of the latter, £4,000 goes to the rates and the remainder to reserve.

Colne.—The Electrical Committee has decided to apply to the L.G.B. for sanction to borrow £550 for electrical mains, in addition to £1,000 already asked for.

Continental Notes.—ITALY.—A power station equipped with 2,000 H.P. gas engines is to be built at Milan. The gas will be generated from peat, and the by-product ammonia recovered.—*Financial News.*

Denny.—The T.C. has resolved to proceed with the erection of an overhead transmission through the main roads of the burgh, also to build a transformer sub-station in connection with the supply of energy by the Scotland Central Power Co. The Burgh electrical engineer is submitting plans and specifications.

Fenton.—The B. of T. has granted a prov. order to Clarke, empowering that Corporation to supply energy in Fenton.

Halifax.—The Borough Electrical Engineer has been instructed to consider and report to the municipality as regards the public lighting in the town, and also in regard to a rearrangement of existing arc lamps.

Havant.—The U.D.C. on May 26th discussed a recommendation that a canvass of the town should be taken in connection with a proposal to obtain a supply of electricity from Portsmouth T.C. It was stated that the price of energy would be equivalent to gas at 3s. 2d. per 1,000 ft., whereas the present price of gas was 4s. It was further announced that the question of the Council supplying energy themselves would be considered by the Committee. Eventually the matter was referred back to the Committee.

Leeds.—The Electricity Committee has recommended the T.C. to engage an independent expert, to advise as to the best method of utilising the joint electrical resources of the Electricity and Tramways Departments for the supply of energy in the Bramley and Rodley districts.

Limerick.—The L.G.B. has sanctioned the loan of £5,500 for electrical extensions, and tenders for the same are being considered.

London.—BERMONDSEY.—The County of London Electric Supply Co. has renewed its offer to supply energy for public lighting at 1½d. per unit for a limited number of lamps, or at 1d. per unit for a comprehensive scheme. The Electric Lighting Committee has decided to take no action in the matter, beyond acknowledging the receipt of the communication.

FULHAM.—The Electricity and Lighting Committee of the B.C., in a report circulated on Monday, states that it has gone carefully into the question of the public lighting of those streets in the Borough at present lighted by flat-flame gas-burners—viz., 1,150 one-burner lamps, eight two-burner, and three three-burner lamps.

The Borough Electrical Engineer has strongly advised that the 5 gas lamps on the line of existing cables should be changed to electric Nernst lighting. The annual cost of the Nernst lamp is £3 7s. 3d. as compared with £3 4s 7d. for an incandescent gas lamp. The Gas Light and Coke Co. submitted photometric tests of the various types of lamps, from which the Committee found that while the incandescent gas mantle gave, if anything, more light immediately round the post, it had not the same distributive or penetrative power as the electric Nernst lamp, which showed up to great advantage. The details of the tests are as follows:—

Distance.	Angle.	Reading.	Illuminating power.
FLAT-FLAME BURNERS.			
11 ft. 7 in. ...	30 ...	14·9 ...	116 candles.
18 ft. 3 in. ...	20 ...	24·1 ...	93 ,,
ELECTRIC ARC.			
35 ft. 5 in. ...	30 ...	14·35 ...	1,170 candles.
NERNST LAMPS.			
19 ft. 10½ in....	20 ...	23·95 ...	112 candles.
10 ft. 7 in. ...	35 ...	17·05 ...	83 ,,
20 ft. 3 in. ...	20 ...	18·2 ...	200 ,,
11 ft. 4 in. ...	35 ...	16·1 ...	106 ,,
INCANDESCENT GAS LAMPS.			
16 ft. 3 in. ...	20 ...	21·8 ...	90 candles.
9 ft. 8 in. ...	35 ...	15·75 ...	81 ,,
15 ft. 3 in. ...	20 ...	24·6 ...	62 ,,
9 ft. 2 in. ...	35 ...	18·9 ...	50·5 ,,

As a result the Committee recommends that all the gas lamps on the lines of existing cables should be converted to electric Nernst lighting, and that the type of lantern designed by the electrical engineer should be adopted, at an estimated inclusive cost of 37s. 6d. per lamp.

STEPNEY.—The General Purposes Committee has recommended that the engineer should be paid an inclusive fee of 100 guineas for his extra work in connection with the Blyth's Wharf scheme, also that other members of the staff, who may be similarly affected, should receive extra remuneration, and that certain temporary additional staff be engaged for the work. It is further recommended that in view of Mr. Wright's engagement as consulting engineer expiring on April 17th last, the Borough Electrical Engineer's salary should be increased to £650 per annum as from that date, and that it should be further increased to £750 as from the date on which tenders for the new works are accepted.

MARYLEBONE.—The B.C. has decided to utilise the adjacent canal water for condensing purposes, with a view to relieving the cooling tower installation.

SHOREDITCH.—The B.C. has forwarded a letter to 27 other metropolitan councils asking them to urge the L.C.C. to convene a joint conference, with a view to discussing the question of co-operation of supply by municipal authorities, on the lines of the recent proposals by the companies.

Maidstone.—The T.C. has decided to supply energy for motors during restricted hours at 1d. per unit, to consumers using more than 195 units per quarter per horse-power demanded.

Manchester.—The chief electrical engineer (Mr. Pearce) has presented to the Electricity Committee of the City Council a statement of the items for which further borrowing powers are required, and an estimate of the cost. The items are as follows:—Stuart Street station: Superheaters and pipework, auxiliary condensing plant, pipework and boiler-feed heaters, £3,250; mains, £63,000. Sub-stations on consumers' premises: Transforming plant, £24,000; switchgear, £8,000. Corporation sub-stations: Didsbury, £2,600; Chorlton, £3,400; Polygon, £1,900; Oldham Road, £1,800; Sherbourne Street, £2,000; Bennett Street, £1,200; Queen's Road, £1,100; Whalley Range, £300; Cheetham Hill, £300; total required, £112,850.

The superheaters are required at the Stuart Street station for at least eight of the Babcock & Wilcox boilers. As regards mains, the L.G.B. has already agreed to grant borrowing powers up to, but not exceeding, a figure equivalent to the past three years' expenditure, with the proviso that before such borrowing powers are exhausted and a fresh application is necessary, detailed statements and plans are to be submitted, showing how the money has been expended.

With reference to sub-stations on consumers' premises, it is proposed to ask the sanction of the Board for the same method to be applied in the case of future plant required for large consumers taking a three-phase supply, as is adopted for mains. As supplies of this nature have only been granted by the Committee during the last 18 months, the estimate has been based on the expenditure of that period.

As regards the Didsbury and Chorlton-cum-Hardy sub-stations, additional traction plant will be required (in the latter case immediately), in order to adequately supply the Palatine Road, Northenden and Sale route, and to cope with the increased traffic on the Stretford, Sale and Altrincham route. Then, as to the other Corporation sub-stations, additional plant will be required by the winter of 1908-9 to cope with the normal growth of the lighting, power and traction demand. At Sherbourne Street it is proposed to substitute two converters, of 250-KW. capacity each, for two existing units of 150 KW. each, the latter being transferred respectively to Whalley Range and Cheetham Hill.

The Bannerman Mills Co. are equipping their large Brunswick mill with electrical plant, and have entered into an agreement with the Corporation for a supply of energy.

Mountain Ash.—The U.D.C. has appointed a Committee to consider what steps shall be taken with regard to the E.L. Order which shortly expires.

Mirfield.—The U.D.C. has decided to install an electric pumping plant at its pumping station, instead of repairing the existing plant.

Portsmouth.—The dockyard authorities have given notice to the T.C. for the termination of the agreement for lighting the Naval Barracks, as these can now be supplied from the dockyard power plant.

Redditch.—A L.G.B. inquiry was held on May 29th into the application of the U.D.C. for loans of £4,000 for electricity purposes and £3,500 for the provision of a refuse destructor. It was explained that of the former sum, £1,407 was for excess capital expenditure. Mr. J. Warner, late chairman of the Electric Supply Committee of the Council, objected to the Council's acting as private traders, as agents for the sale of motors and the sale of lamps. With reference to the refuse destructor, it was stated that the steam could be utilised for the production of electricity. Some of the property owners and residents of the district objected to the destructor.

Wednesbury.—The T.C. has been recommended to apply for a loan of £8,000 for additional plant to generate electricity, instead of purchasing, in bulk from the Midland Electric Corporation.

Wigan.—The T.C. has fixed the price of energy for motive power at 2d. per unit for under 2,000 units per annum, and 1½d. beyond, the latter being an increase of ¼d. per unit. For the tramways the price of energy is to be reduced from 1½d. to 1¼d. per unit.

Worcester.—The Electricity Committee of the T.C. has decided to apply for a loan of £10,000 for additional plant, including a 400-KW. direct-current generator, mains, services, meters, &c.

Worksop.—The U.D.C. has applied to the L.G.B. for a loan of £2,000 for cables, feeders and an economiser.

TRAMWAY and RAILWAY NOTES.

Bradford.—The accounts of the Corporation Tramways Department show a total revenue for the past year of £237,511, and an expenditure of £164,987, leaving a trading profit of £72,524, against £70,279 in the previous year. Interest on capital absorbs £25,000, income-tax £2,543, rent of leased lines £4,173, and repayment of capital £29,483, leaving a net surplus of £14 536, which is some £2,900 more than in the previous year. £10,000 of this amount will go to the relief of the rates. The parcels department, with earnings of £5,004 during the year, shows a profit of £972, against one of £526 in the previous year.

Burnley.—The Corporation electrical tramways department has experienced its most successful year. The profits are represented by £8,766, all of which will be devoted to the departmental reserve fund.

Continental Notes.—ITALY.—Some capitalists at Milan and Savona have formed a company for setting up electric power works in the Valley of Albenga, with a view to supplying the principal industries, and, eventually, a tramway service along the Western Riviera, with electric power.—*Financial News.*

GREECE.—The Societe des Tramways d'Athenes et du Pirée has commenced operations in connection with the conversion of its system to electric traction, and it is expected that 25 miles of electric tramways will be in operation by September, 1908.

MADRID.—Application has been made by the "Campania Electrica Medrilena de Traccion" for the concession of an electric tramway between the Calle de Alcalá and the Plaza de la Independencia.

GERMANY.—It is reported from Berlin that the latest proposal—on paper, apparently again—is a scheme for the introduction of electrical working on a railway section in the West of Prussia. Calculations have been made in regard to this particular line, and it has been found that the adoption of electric traction would permit of a considerable economy being realised. It is proposed to make provision in the budget of 1908 for the expenditure on the conversion of the railway, so that the execution of the work may, perhaps, be commenced in the month of May next year.

Dartford.—The Light Railway Commissioners have submitted to the B. of T for confirmation, an order amending the Dartford District Light Railways Order, 1903.

Ealing.—The T.C. is endeavouring to secure the co-operation of neighbouring authorities in an action for an injunction against the London United Tramways Co. in respect of the noise of the trams. So far, the authorities appealed to do not seem inclined to fall in with the proposition.

Glasgow.—Mr. James Dalrymple, the general manager, has submitted a report on the question of tramway fares. Of late, strong efforts have been made either to secure an extended distance for the popular halfpenny fare, or a reduction on taking a quantity of tickets, while season tickets have also figured in the representations made to the Tramways Committee. Contrary to general opinion, Mr. Dalrymple shows that the halfpenny fare, which forms 20·4 per cent. of the drawings of the tramways, is not a concession to the working man, but is chiefly used by business people in the centre of the city. The penny fares which pass four halfpenny stations, are the source of revenue, no less than 72·3 per cent. accruing from that fare. The longer distances representing 1½d., 6·2 per cent.; 2d., 0·94 per cent.; 2½d., 0·06 per cent. The manager emphatically proves that the extension of the halfpenny distance would, by killing the penny fare, turn the present highly financially successful result into a corresponding loss. Season tickets, he deprecates, as not worthy of consideration. Of course, in dealing with the halfpenny fare, the topography of Glasgow had much to do with the question, its principal junctions and centres being so distanced as to admirably lend themselves to the establishment of the halfpenny fare.

The end of the financial year of the tramways took place on Friday last, and the following are the principal statistics:—Average track mileage open during year (single), 168½ miles; increase, 15½ miles. Car mileage, 26,350,367 miles; increase, 1,463,457 miles. Traffic receipts, £887,380; increase, £73,612. Traffic receipts per car-mile, 10·46d.; increase, ·12d. Passengers carried, 224,063,098; increase, 16,004,750. The following statement gives the number of passengers carried at each fare:—½d., 64,453,380; 1d., 134,109,727; 1½d., 16,398,501; 2d., 4,831,664; 2½d., 2,009,645; 3d., 1,311,436; 3½d., 766,328; 4d., 182,417; total, 224,063,098. Since the beginning of the year, a number of extensions have been opened for traffic. These have been—Lambhill, Dumbreck, Paisley Road and Mount Florida, Garngad and Uddingston. The total length of these extensions measures 7¾ miles of route. For minuter comparison, the following are the previous year's statistics:—Average track mileage open during the year, 153¼; increase, 8½ miles. Car-mileage, 18,886,910 miles; increase, 943,315. Traffic receipts, £813,768; increase, £57,288. Passengers carried, 208,058,348; increase, 12 290,829. The previous year's extensions were Giffnock, Pollokshields, Bailliestou, Springfield Road, Rouken Glen, Kil'ermont and Barlinnie. Total length, 6¾ miles.

Halesowen.—A deputation of the U.D.C. attended before the Light Railway Commissioners in London on April 29th, with reference to the transfer of the London Company's Light Railways Order. An amicable settlement was arrived at, and the transfer is to be granted by the B. of T. upon satisfactory terms to the U.D.C. It is now hoped that the work of constructing the tramways will be commenced without delay.

London.—The London United Tramways, Ltd., has given notice of an intended application to the Light Railway Commissioners for an extension of time for the construction of the railways authorised by the order of 1904.

Manchester-North Wales.—A scheme is on foot in Manchester whereby it is proposed to build an electric railway to North Wales, on the lines of the Blackpool and Fleetwood Tramroad. The tentative scheme embraces a terminus at Old Trafford, Manchester, junctions with certain existing railways having connections with North Wales, and a direct tramroad right across Cheshire to Wrexham. It is proposed to have numerous stopping places for picking up passengers at various points on the route, instead of the usual railway stations at regular intervals.

Merthyr Tydfil.—The T.C. has received from the B. of T. an extension of two years for carrying out the light railway order.

Sunderland.—The annual report of the Corporation tramways department for the year ended March 31st, 1907, shows a gross income of £72,396, of which £72,054 was traffic revenue, representing 11·261d. per c.m. The working expenditure was £40,822, or 6·379d. per c.m., and the balance carried to net revenue account, £31,574. After meeting interest on capital £8,751, and income-tax £469, the sum of £23.056 was carried to the appropriation account, which it was suggested should be disbursed as follows:—Loan repayments, £9,014; reserve and renewals fund, £6,259; in aid of borough rates, £7,123, with other small expenditures. In the reserve and renewals fund there is £30,454, of which £23,454 is earmarked for renewals, £5,000 for reserve, and £2,000 for compensation reserve fund. Since the inauguration of the system £294,461 has been borrowed, and the loans now outstanding are £233,485. The sum of £26,679 has during that time been carried to the credit of the borough fund account in the reduction of rates.

Victoria (Australia).—A conference of the representatives of the Kew, Hawthorn, Malvern, Caulfield and St. Kilda municipalities has recommended the construction of a tramway between Kew and St. Kilda. Estimates show a total cost of £72,790; an operating expense of £8,900 per annum, with a separate power house, and £8,000 per annum with a joint power house. The revenue is estimated at £14,120, and the gross profit at from £5,000 to £6.000.

Last week the Right Hon. T. Bent, Premier of Victoria, with Mr. Tait, Chief Commissioner of Victorian Railways, inspected the North-Eastern and Lancashire and Yorkshire electrified routes, with a view to gathering such data and information as would be useful in connection with the conversion to electrical working of some 100 miles of suburban lines in Victoria, the matter being under consideration.

Wallasey.—The Tramways Committee has decided to recommend the Council to carry out extensions of two existing tramways, at estimated costs of £26,034 and £22,661. The Committee has considered, but will not at once recommend, the construction of a section from Wallasey Village to Sandy Lane, at an estimated cost of £31,576; and Wallasey Village and Grove Road, from Sandy Lane to Warren Drive, at an estimated cost of £16,458.

Walthamstow.—We are informed by Mr. Murray, the tramways manager, that the matter contained in our note of last week was merely a recommendation of the Committee, which was not adopted by the Council in view of the marked improvement which has taken place in the traffic returns and management of the undertaking. We may congratulate Mr. Murray on the fact that the deficit of £5,300 in 1906 has, during his tenure of office, been reduced to £1,900 in 1907.

West Ham.—The first six months of the through running tramway agreement between Leyton and West Ham expired on May 31st, and the result, from a financial point of view, is considered to be so unfavourable to West Ham that a revision of the arrangement is desired by the borough.

Wigan.—Arising out of the loss of £16,000 on last year's working of the borough tramways, notices of motion have been given for the next meeting of the Town Council that the tramways manager be asked to resign, and that the salary of the tramway accountant be reduced.

Willesden Green.—Commencing from this week, combined tram-and-rail tickets are being issued, at reduced fares, from Baker Street to Edgware, changing from train to tram-car at Willesden.

TELEGRAPH and TELEPHONE NOTES.

New Zealand.—*Telegraphs.*—There were during 1904-5 12,782 kilometres of line and 38,140 of wire, this being an increase over 1903-4 of 266 kilometres of line and 1,262 of wire. Of submarine telegraph cable there were 523·7 kilometres; offices numbered 1,247, or an increase of 47 over the previous year. Traffic has increased during the year under review by 194,548 telegrams, to 5,159,745 telegrams. Of this total 3,720,114 were ordinary, 367,066 Press, 187,027 urgent, and 626,288 service telegrams. It is interesting to note how this traffic was apportioned between the Pacific and Eastern extension cables. The former secured 74,084 ordinary and 486 Press telegrams, while the corresponding figures for the latter were 12,395 and 1,065 respectively. The grand totals are, therefore, for the Pacific, 75,290; for the Eastern extension, 13,460. Receipts totalled 4,275,042 fr. (£171,001), exclusive of the value of Government telegrams. This shows an increase over the previous year of 127,100 fr. (£5,084).

Telephones.—This system comprised 1,264 kilometres of line and 17,744 of wire, this being an increase over the preceding year of 104 kilometres of line and 1,921 of wire. There were 13,423 subscribers and 85 stations. Of the former Wellington possessed 2,260, Auckland 1,854, Dunedin 1,702, and Christchurch 1,647. Receipts on account of this service amounted to 1,976,534 fr. (£79,061), or an increase of 200,826 fr. (£8,033) over the previous year. Expenses on account of the telegraph and telephone services amounted to 6,474,438 fr. (£258,977). Subsidies for submarine telegraph cables are not included in these figures. Up to April 1st, 1905, the Treasury of New Zealand spent 28,324,756 fr. (£1,132,990) for the construction of telegraph and telephone lines. —*Journal Télégraphique.*

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Cayenne-Pinheiro	Aug. 18, 1902	..
Curacao-Coro	Closed..	..
Curacao-La Guayra	Jan. 12, 1906	..
Curacao-Maracaibo		
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904	..
Garachico-Santa Cruz	July 12, 1906	..
Las Palmas-Arecife	Aug. 18, 1906	..
LANDLINES.		
Puerto-Barrios	Aug. 2, 1902	..

Telephone Agreements.—On Tuesday, before Judge Lumley Smith in the City of London Court, the National Telephone Co. sued Mr. J. Carruthers and Mrs. H. C. Hemmings, of the "Threo Syndicate," for £6 19s. 8d. the rental of a telephone for a second year. The defendants took the telephone for three months, paying in advance for 12 months. After six months the company found the premises vacant and removed the telephone, which was held at the defendants' disposal; but as no notice to discontinue had been given, the defendants were liable for a second year's subscription. The case was adjourned.

CONTRACTORS' COLUMN.

OPENINGS FOR NEW BUSINESS.

ACCRINGTON.—New public schools (accom. 720). Fairhurst & Holt, architects, 54, Church Street, Accrington.

ACTON, W.—Villa residences in Goldsmith Avenue. R. T. Hayes, architect Birkbeck Grove, Acton Vale.

Shop and house in Roslin Road, Acton. R. T. Hayes, architect, Birkbeck Grove, Acton Vale.

BOLTON.—New (central) post-office. Postmaster, Bolton.

New hospital at Fishpool Workhouse, Bolton (£11,000). J. Tyson, Wellington Saw Mills, Bolton, builder.

BRISTOL (MERRYWOOD).—Public school (£6,000). H. Dare Bryan, architect, 4, Unity Street, Bristol.

BURY.—Additions and improvements to Albion Mills. J. H. Openshaw, Elton.

Extensions to print works at Bolholt. Horridge & Connall, owners.

CARDIFF.—New offices at the Docks (£20,000). H. Budgen, architect.

DONCASTER.—New Primitive Methodist Church, Thorne. W. G. Smithson, architect, 13, Bond Street, Leeds.

EARBY.—Weaving shed for the Earby Weaving Shed Co. Apply to the Secretary.

ILFORD.—E.L. wiring and fittings for Water Lane school. C. J. Dawson, architect, 11, Cranbrook Road, Ilford.

LEADGATE (Co. DURHAM).—New public schools. G. T. Wilson, architect, 21, Durham Road, Blackhill, R.S.O.

LEEDS (LOWER WORTLEY).—Additions to Standard Works for Wm. Fox and Co. Howdill & Howdill, architects, 7, Oxford Row, Leeds.

LEVENSHULME.—Rebuilding "Pack Horse" Hotel, Stockport Road. N. H. Hacking, 50, Blackfriars, Manchester, architect.

LEWES (ALFRISTON).—Public elementary school. F. J. Wood, County Surveyor.

LIVERPOOL.—Convalescent home, Freshfield. Estates Office, Birkdale, and C. J. Weld-Blundell, Blundell House, Campden Hill, Kensington, London, W.

Large licensed premises for Cain & Son in Lime Street. Henshaw and Sons, builders, Chatham Hill, Liverpool.

LONDON (WANDSWORTH).—Parish Hall. W. Johnson & Co., Ltd., Wandsworth Common, builders.

(STREATHAM).—Schoolrooms, &c., in connection with Baptist Church. Battley Sons & Holness, 21, Old Kent Road, S.E., builders.

(WHITECHAPEL).—Buildings on site of Nos. 42-46, Hanbury Street. J. R. Moore-Smith, 14, Union Court, Old Broad Street, E.C., architect.

(WANDSWORTH).—Additions to Acme Laundry, 226, Garratt Lane Wandsworth.

(TOTTENHAM).—Stores and stabling for Truman, Hanbury & Co., brewers, Brick Lane, E.

(KENSINGTON).—Additions to St. Andrew's Mission Hall. E. H. Bullock, 3, Raymond Buildings, Gray's Inn, W.C., architect.

(WESTBOURNE GROVE, W.).—Two shops. J. A. L. Gimblette, 118, Westbourne Grove, W., architect.

(TOTTENHAM).—Store in High Road, for Edmonton Co-operative Society, Ltd., 57, Church Road, Tottenham.

(MARYLEBONE).—Buildings. H. Horton, 199, Piccadilly, architect.

(VICTORIA DOCK ROAD, E.).—Billiard saloon (£1,458). J. M. H. Gladwell, Essex House, High Street, Stratford, E., architect.

(FOREST GATE, E.).—Additions to Methodist Church (£1,192). G. Barnes & Son, 5, Clement's Inn, Strand, W.C., architects.

(BOWES PARK, N.).—Congregational Church (£5,000). P. Morley Horder, 148, New Bond Street, W., architect.

(STRATFORD, E.).—Timber factory (electric power to be used). Shurmer & Sons, Clapton, builders.

(LEWISHAM).—Concert hall and billiard room. W. Wadman, Perry Hill, S.E.

(LEWISHAM).—Additions to laundry. S. J. Jerrard & Sons, Horton Street, Lewisham, builders.

(LEWISHAM.)—Hall and club room. Victor Wilkins, 24, Finsbury Square, E.C., architect.

(LEWISHAM).—Forty-nine houses. Norfolk & Prior, architects, Catford, S.E.

MANCHESTER.—New municipal baths in Harpurhey. City Architect.

New warehouse in Granby Row, for Messrs. Oxendale & Co. Architect, H. Goldsmith, 63, Faulkner Street, Manchester.

NEWPORT (MON.).—Shops and arcade. Chas. D. Phillips, owner, Newport (Mon.).

NOTTINGHAM.—Extension of Welbeck Hotel (£5,000 to £6,000). Home Brewery Co., Nottingham, owners.

OLDHAM.—New factory for the Iris Spinning Co. Apply to the secretary.

PENTRE (RHONDDA).—County Court Offices. W. D. Morgan, Pentre, architect.

PONTEFRACT.—Variety hall. Garside & Pennington, architects, Ropergate House, Pontefract.

PURDYSBURN (Co. DOWN).—Lunatic Asylum, Villa Colony. Scheme under the consideration of the Finance Committee (£75,000).

ROTHERHAM.—Higher school (£13,000), and extensions to Grammar School (£7,000), to be carried out by T.C.

RYE (SUSSEX).—Grammar school. G. Ellis, builder, Rye.

ST. ALBANS.—Workshops for the Midland Railway Company. Engineer, Derby Station.

STROOD (ROCHESTER).—New Railway Station (S.E. & C. Rly.) (£4,800). Wallis & Sons, builders, Hart Street Works, Maidstone.

SUNDERLAND.—New Presbyterian Church, Roker. Cackett & Burns Dix, architects, Pilgrim House, Pilgrim Street, Newcastle-on-Tyne.

TICKHILL and MALTBY.—Station buildings for the South Yorkshire Joint Railway. E. Parry, engineer, 28, Park Row, Nottingham.

TODMORDEN.—New spinning mills (180,000 spindles). Proprietors, the Hare Spinning Co., Ltd., newly formed.

TONYPANDY.—Rebuilding Cross Keys Hotel, Dunraven Street. J. T. Jenkins, Porth, Rhondda, architect.

TUNSTALL (STAFFS.).—New public schools, Summer Bank. A. R. Wood, architect, Tunstall.

UPPER PARKSTONE (DORSET).—Baptist Tabernacle (£3,000). Lawson and Reynolds, architects, Bournemouth; Jones & Seward, builders, Westbourne.

WASHINGTON (Co. DURHAM).—New public schools. J. W. Hanson, architect, 79, King Street, South Shields.

WESTHOUGHTON.—New industrial works. J. Haworth, Slack Lane, Westhoughton.

WIGAN.—Weaving mill at Pemberton. R. Pennington, Malvern Chambers, Library Street, Wigan.

WOLVERHAMPTON.—Roman Catholic Pupil Teachers' Centre. Sandys, architect, Stafford.

Extension of Spring Vale Steel Works (electrically equipped).

Manufacture of Calcium Carbide.—French patents have been taken out by A. J. Petersson for improvements in the manufacture of calcium carbide. In the first specification the author describes a method of charging the furnace with alternate quantities of lime and carbon instead of mixing the raw materials beforehand. The charge is introduced in such conditions that the carbon is chiefly brought into contact with the electrodes, while the lime is kept as far as possible away from them. It is claimed that the efficiency of the process is in no way reduced by working in this manner, whilst the consumption of electrodes is reduced to a minimum. In a second patent the inventor describes a somewhat similar method of charging the furnace, the lime and coal being introduced in columns or layers. The electric current is caused to pass through the layers of coal, when the volatile constituents are ignited and their flame serves to heat the lime before the latter arrives in the zone of reaction. The advantage claimed for this modification is that the carbon monoxide is utilised more advantageously than heretofore, it being only necessary to see that a sufficient quantity of air enters the furnace to burn the gas to carbon dioxide.

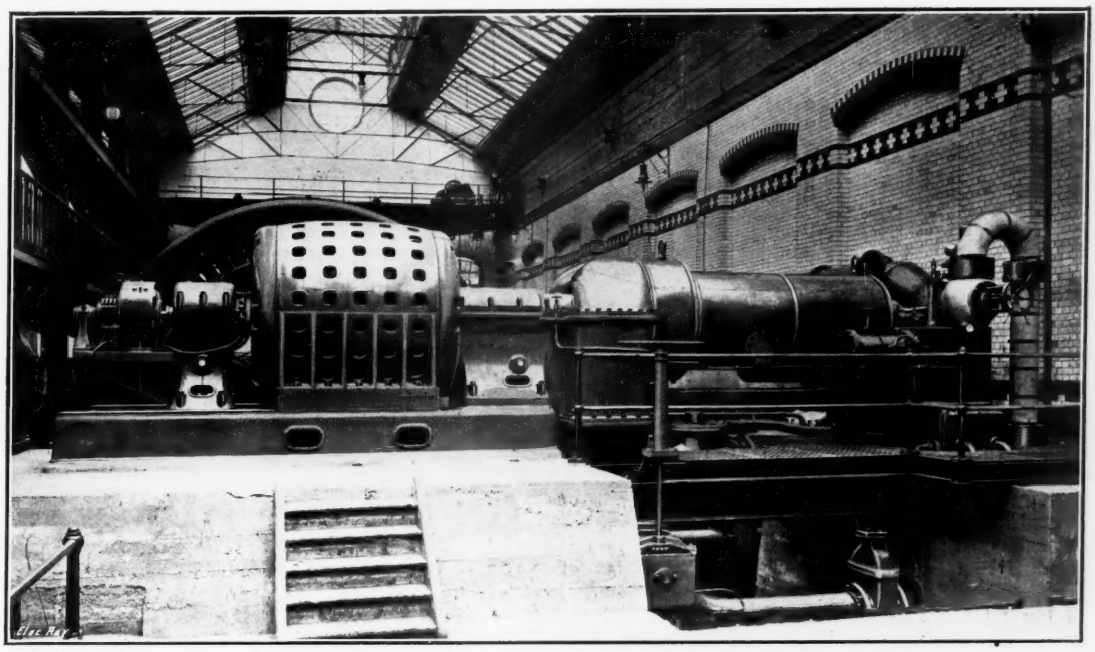
THE WILLANS-DICK, KERR TURBO-GENERATOR.

THROUGH the courtesy of Messrs. Willans & Robinson and Messrs. Dick, Kerr & Co., we were enabled, on Friday last, to inspect some recent examples of these well-known constructors' turbo-generators at the Rugby works of the first-named firm.

In this connection, it is interesting to record that Messrs. Willans & Robinson have supplied or on order some 62 turbines up to the present, of a total capacity of 90,000 K.W.

The feature of interest on the occasion of our visit was a 2,000-KW. Willans-Dick, Kerr turbo-alternator, one of two built to the order of the Sydney Municipality.

The specification for these machines was drawn out by Mr. T. Rooke, the electrical engineer to the Municipality, and tenders were publicly advertised for the plant in question.



WILLANS-DICK, KERR 1,500-KW. TURBO-ALTERNATOR AT THE ISLINGTON ELECTRICITY WORKS.

Before finally choosing his plant, Mr. Rooke made a tour of inspection of all the principal turbine installations in this country, on the Continent and in America, and that his choice should have fallen on a British design is in every way satisfactory.

The complete contract for the work in question was given to Messrs. Dick, Kerr & Co., whilst the turbines and surface condensers were sub-let to Messrs. Willans & Robinson, Ltd. The interests of the Municipality of Sydney in this country are in the hands of Messrs. Preece & Cardew, who have witnessed the necessary tests on the plant prior to shipment.

As already mentioned, the turbines are of a normal output of 2,000 KW., and are arranged to give an overload of 20 per cent. for periods of two hours. To obtain the full load non-condensing, the turbines are fitted with pass-valves.

The normal working pressure at the boilers is 150 lb. per sq. in., whilst the steam is superheated between limits of 85° F. and 145° F. The turbines are arranged for a speed of 1,500 R.P.M., and exhaust into a vacuum of 27½ in.

The air pumps for the condensers are of the Edwards three-throw type, running at a speed of 108 R.P.M., and driven through single reduction gearing by 22-B.H.P. three-phase motors running at 585 R.P.M.

The Gwynne circulating pump is in each case capable of delivering 2,950 gallons per minute when working against a head of 22 ft., and is driven by a 35-B.H.P. three-phase motor running at 580 R.P.M.

The alternators are of Messrs. Dick, Kerr's three-phase type, arranged for a pressure of 5,200 volts, 50 cycles per second, and to give an output of 2,000 KW. when working on a power factor of ·85.

Each alternator has an exciter direct coupled on its shaft, the excitation pressure being 100 volts.

The special features of the Willans-Parsons turbine are now fairly generally known, but attention might be drawn to the following points in which this type of turbine differs from others manufactured under the same licence :—

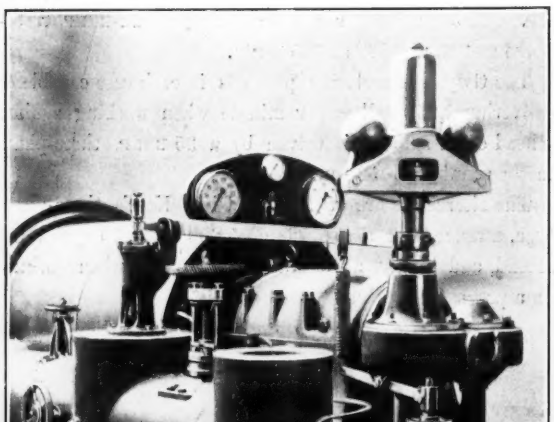
Usually the three balance pistons are placed on the high pressure end of the turbine; Messrs. Willans & Robinson, however, consider it an advantage to dispense with the third and large diameter balance piston on the steam end, and to admit steam through the interior of the rotor to the low pressure end, which acts as the third balance piston.

The body of the turbine is built up in three sections instead of being cast in one piece; this enables the machining of each section to be carried to a very much finer limit than would be possible if the complete case had to be machined in one length.

The system of shrouded blading (now well-known) makes

it possible to build up the blades in half rings to stock ready for assembling in the rotor and casing, and also allows of the use of larger clearances with the same resulting steam economy.

The governor gear is simple but effective. Oil and steam relays are omitted, and an ordinary centrifugal governor acts direct on to a throttle valve, as shown below.



VIEW OF THE GOVERNOR GEAR, WILLANS TURBINE.

The accessibility and general simplicity of the arrangement of the turbine are also important points.

The rotors are all machined to $\frac{1}{1000}$ in., limits of accuracy both inside and outside; the end shafts on the steam ends of the rotors are also forged solid in one piece with the rotors, in all except the largest sizes of turbine.

All the rotors and casings are "machined" after the blading is complete and in position, and it is a point of considerable advantage in favour of the shrouded blading that this should be possible, as it, of course, ensures accurate clearance.

Absolute interchangeability of all corresponding parts of turbines of a similar size is guaranteed, including interchangeability of the bladed rotors. This latter point might be emphasised, as it has hitherto been found impracticable to guarantee interchangeability of the rotors. An inspection of one of these rotors tends to convey the impression that, due to the large number of projecting parts, the obtaining of interchangeability necessitates working to very close limits.

Turning to the Dick, Kerr turbo-alternator, the most recent designs embody some improvements which are worthy of note.

As distinguished from many turbo-alternators of foreign origin, the standard Dick, Kerr alternator is of the salient pole type.

This construction with its lower magnetic leakage in field and armature is conducive to better inherent regulation; it enables machines to be designed with lower stator iron losses, and, in conjunction with the possibility of using a larger amount of copper in the rotating field, increases the efficiency considerably.

The mechanical design is such that the maximum stresses to which the material is subjected are never more than 20 to 25 per cent. of the elastic limit of the material used, giving a factor of safety between 4 and 5; the ventilation of the machine is also a special feature, although forced draught is not employed.

A departure in the Sydney machine appears to be the use of solid end shields, which no doubt has a material influence in reducing the noice, and prevents dirt from being drawn into the machine.

Dick, Kerr machines of a similar design have already been supplied, or are being constructed for:—Bristol, Leeds, Glasgow, Hastings, Islington, Metropolitan Electric Supply Co., Midland Electric Corporation, St. Pancras, South Metropolitan Electric Supply Co., Sunderland, Sydney (N.S.W.), West Ham, Lancashire and Yorkshire Railway Co., &c.

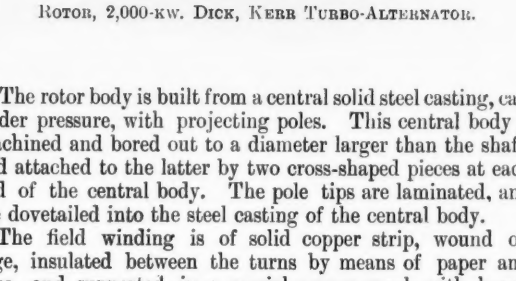
The Sydney machine itself is designed to give an output of 2,000 KW. when working with a power factor of ·85.

The stator is slot wound, with mica insulation. Special ventilating ducts are provided in the frame, and it is possible to slide the stator in a direction parallel to the shaft, so as to uncover the rotor for easy inspection.

ROTOR, 2,000-KW. DICK, KERR TURBO-ALTERNATOR.

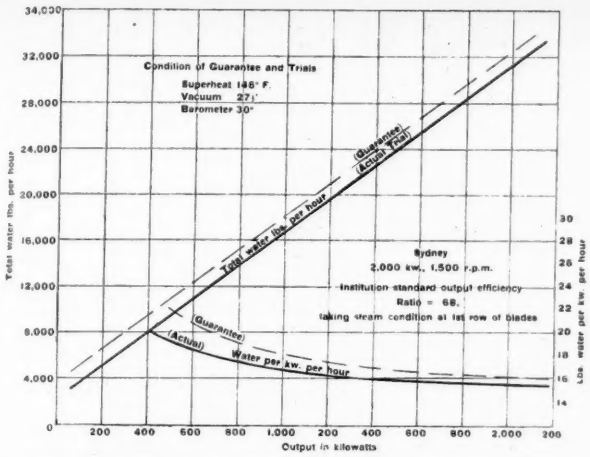
The rotor body is built from a central solid steel casting, cast under pressure, with projecting poles. This central body is machined and bored out to a diameter larger than the shaft, and attached to the latter by two cross-shaped pieces at each end of the central body. The pole tips are laminated, and are dovetailed into the steel casting of the central body.

The field winding is of solid copper strip, wound on edge, insulated between the turns by means of paper and mica, and supported in a special copper spool with heavy insulated flanges. The spools, after being formed and



STATOR, 2,000-KW. DICK, KERR TURBO-ALTERNATOR.

insulated, are subjected to hydraulic pressure in the axial direction, of about 50 per cent. above the pressure to which they would be subjected from centrifugal action in normal running; the terminal leads are composed of very thin and flexible copper strips. Between the spools, special wedges provide against the horizontal component of the centrifugal force, which tends to open the spools.



CURVES SHOWING GUARANTEED AND ACTUAL STEAM AND WATER CONSUMPTION OF THE SYDNEY TURBINES.

Cast-iron collector rings are provided, shrunk hot over special micanite rings, which are built up directly on the steel shell of the collector ring. The leads from the fields coils are protected by means of special metallic caps, which are fitted over the shaft and to the end of the rotor body. The connection of the leads to the collector rings is also protected by a special cap, which is easily removable for inspection if necessary.

The brushes are of special graphite of very low friction, co-efficient and high conductivity.

The design of the machine embraces sizes from 500 up to 10,000 KW., and the variation in periodicity which obtains anywhere imposes no special difficulties in construction. Already machines have been supplied under extremely varying conditions of periodicity and voltage; in one case the conditions calling for a single-phase machine at a periodicity of 100.

Mr. Izod and Mr. Fox, of Messrs. Willans & Robinson, gave the visitors a most instructive and exhaustive dissertation on every possible detail connected with the construction of their turbines, and Mr. H. Scholey briefly alluded to the special features of the already well-known Dick, Kerr generators.

In conclusion, we are indebted to the two firms interested for the opportunity which the visit afforded of seeing and recording the recent improvements in their machines, as also for the excellent illustrations which we reproduce.

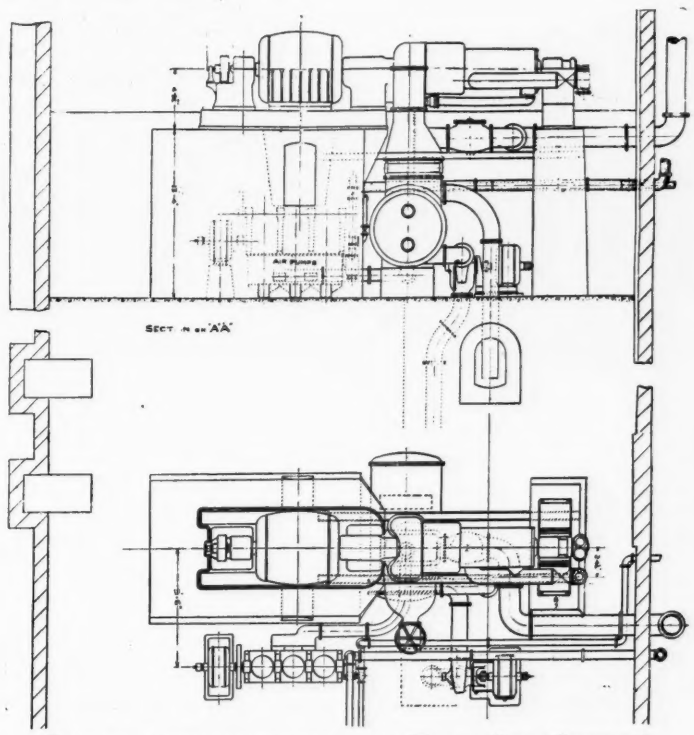


DIAGRAM SHOWING ARRANGEMENT OF THE WILLANS TURBO-GENERATOR AND AUXILIARY PLANT.

ELECTRIC TRAMWAYS AT DUMBARTON.

THE inauguration of the Dumbarton electric tramway system took place on February 20th last. These tramways have been laid down and equipped throughout by Messrs. Crompton & Co., for the Electric Supply Corporation, who hold powers for running them under the Light Railways Act.

The system serves the principal streets of the town, and runs to the borough boundary in three directions.

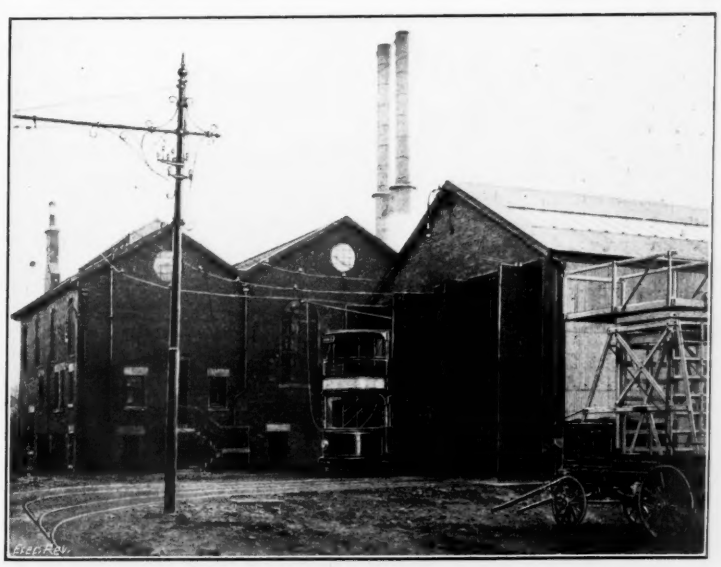
The track is principally single-line with turnouts, but double-line is laid in some sections of the principal streets.

The rails, of manganese steel, weigh 90 lb. to the yard, and are laid to a gauge of 4 ft. $7\frac{3}{4}$ in., on concrete foundations, the roadway being finished with Whinstone sets. The points and cross-overs are of cast-steel, supplied by Messrs. Hadfields, of Sheffield.

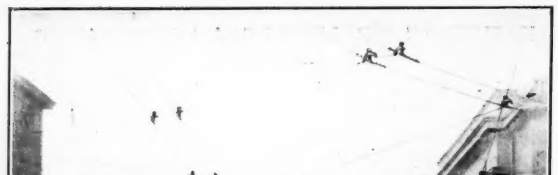
Difficulties in construction were encountered where the track passes under two railway bridges, and in each case it was necessary to lower the roadway in order to obtain sufficient head-room for the cars. It was also necessary to erect a new steel girder bridge to carry the track across Gruggies Burn.

Separate trolley wires are provided for up and down traffic, of 2/0 section and grooved; and the steel tubular poles are minus the usual cast-iron bases.

The overhead system is fed from three feeder pillars connected to a trunk main on the power station; and the B.M.R. system of signalling is provided at certain places.



EXTERIOR OF THE POWER STATION AND CAR SHEDS, DUMBARTON.



STREET VIEW, DUMBARTON, SHOWING TRAMWAYS.

At the present time six cars are running; these are of the four-wheel type, with radial trucks, each car seating 56 passengers and being provided with a top cover. The car equipments include two 30-B.H.P. motors and controllers of the Westinghouse type. The gauge of the track and general design of the cars corresponds with those features of the Glasgow undertaking, it being intended at an early date to connect this tramway system with that of Glasgow through the Dumbarton County Tramways, for which powers have now been obtained.

The power station is designed for supplying energy for lighting and motive power purposes in the town as well as for the tramways. Its equipment includes three direct-coupled sets, two having an output of 185 KW. and one of 50 KW. The engines are of the Belliss compound, two-crank enclosed type, working at 180 lb. steam pressure and exhausting to atmosphere.

The generators are Crompton multipolar open-type machines, designed to give from 480 to 550 volts pressure.

An important feature of this station is the use of storage batteries and automatic reversible boosters for regulating the load on the generators and the pressure on the bus-bars. These boosters work on the "Crompton-Mackintosh" system, and enable the battery automatically to provide for the fluctuations in the load, keeping the load on the generators constant throughout the day.

There are two separate switchboards, one for the lighting and the other for the traction system.

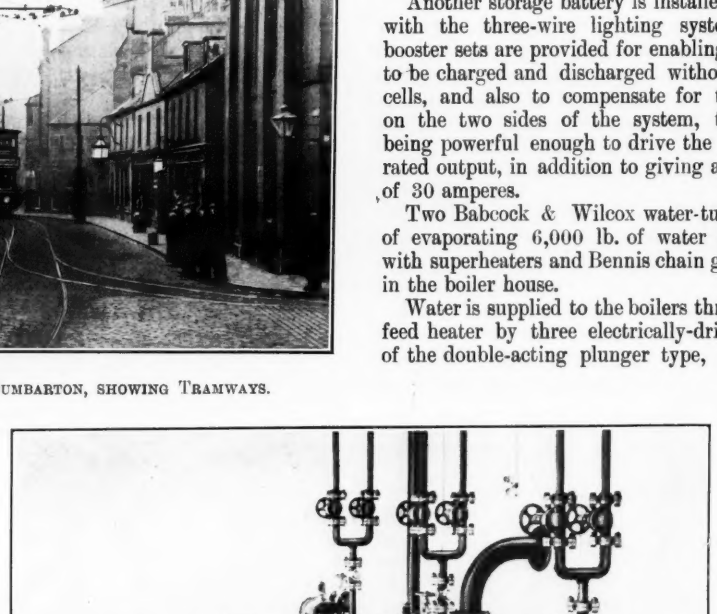
The whole of the circuit breakers on both boards are Messrs. Crompton's "C.B.H." free handle type, and operate with overload or reverse currents in the case of the generators, and overload only for the feeders.

The connections between the dynamos, feeders and switch-gear are of bare copper secured to porcelain insulators.

Another storage battery is installed for use in conjunction with the three-wire lighting system, and two balancer-booster sets are provided for enabling these lighting batteries to be charged and discharged without the use of regulating cells, and also to compensate for the inequalities of load on the two sides of the system, the balancing machines being powerful enough to drive the boosters at their normal rated output, in addition to giving an out-of-balance current of 30 amperes.

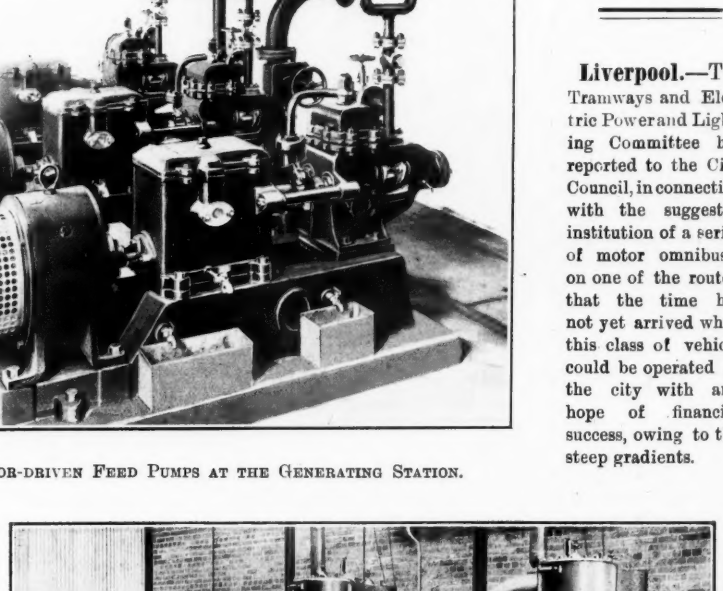
Two Babcock & Wilcox water-tube boilers, each capable of evaporating 6,000 lb. of water per hour, and provided with superheaters and Bennis chain grate stokers are installed in the boiler house.

Water is supplied to the boilers through a "Worthington" feed heater by three electrically-driven pumps. These are of the double-acting plunger type, connected through self-contained worm gears to "Crompton" enclosed type motors. The combined efficiency of these pumps is over 60 per cent.



CROMPTON MOTOR-DRIVEN FEED PUMPS AT THE GENERATING STATION.

Liverpool.—The Tramways and Electric Power and Lighting Committee has reported to the City Council, in connection with the suggested institution of a series of motor omnibuses on one of the routes, that the time has not yet arrived when this class of vehicle could be operated in the city with any hope of financial success, owing to the steep gradients.



VIEW OF THE GENERATING PLANT, DUMBARTON ELECTRICITY WORKS.

THE BOW TROLLEY.

By GERALD HOOGHWINKEL, M.I.E.E.

About once a year one of the electrical papers contains a short notice about the real or imaginary advantages or defects of the sliding contact bow. The writer has on several occasions challenged a discussion by practical engineers, preferably with some knowledge or experience of the bow, on its merits, but the only results from an article in the *American Street Railway Journal* were an editorial veto and a warm defence of the American born wheel trolley.

It would be useless, and bordering on monotony, to repeat the various results obtained on many thousands of miles of urban and inter-urban electric tramways in Germany and elsewhere, results which have been confirmed by the only application in this country—viz., Sheerness, where the bow system was inaugurated by the writer some five years ago.

The writer hopes not to trespass on the Board of Trade inspector's official reticence, by stating that at the trial trips that gentleman expressed his complete satisfaction, especially on the point of safety from de-wiring. Nearly 80 per cent. of the accidents with overhead wires, can be traced to de-wiring of the trolley. With single-decked cars the complete absence of any turning or handling of the current collector is also, especially with heavy traffic, a decided advantage. The question of wear of wire and trolley is a debateable one, and may be left to the last.

One of the most important points, however, is the lightness and simplicity of the overhead construction. This tends to become heavier and heavier, and in towns like Liverpool and Manchester becomes a veritable black canopy, giving rise to many mishaps if stringent and periodical inspection is not enforced. With simplicity and lightness due to the shape of the contact and the lesser pressure which is required to retain contact, comes a reduced number of poles and reduced costs. This may not seem much, but I have found that on an average, taking over 20 large towns on each system, a saving of over 20 per cent. in poles and over 35 per cent. in overhead material could be made. As to the appearance, anybody will admit that the absence of frogs and heavy switches would materially improve the aspect of our squares and street crossings. Anyone who has visited the cities of Cologne, Amsterdam or Frankfort will testify to this point.

The writer's real object, however, in writing this short communication is to refute the few remarks by Mr. Eugen Eichel, which were reprinted in the May 24th issue of the Electrical Review, from the *Street Railway Journal*. Mr. Eichel especially mentions Saxony and Dresden, as if the bow was only used in that Kingdom, and that, because of its being a local product. The bow was first used in Dresden, but has since been installed in all the towns where tramways were constructed by Messrs. Siemens & Halske, and even in cities where the work has been done by their rivals. The reason why its use was not extended to all towns was a patent question at first, and later on, merely a question of commercial tactics. However, for mining locomotives, high-voltage current collection, high-speed railways, and such applications other than tramways, nearly all the most important Continental manufacturing companies have adopted the bow trolley. In such important cities as Amsterdam and The Hague, where the authorities had no preference, and where the choice was made after exhaustive inspections and studies, the bow system has been installed, and the overhead construction in these cities is neater and far more pleasing than anything to be found in this country or in the States. In the cities above referred to, where the writer acted as adviser to the tramway company, the installation was not carried out by the Siemens firm.

The assertion that the Schuckert Co. before its amalgamation with the Siemens Co., issued a pamphlet stating that the trolley bow (which at that time was exclusively a Siemens patent) caused abnormal wear on the overhead wire, is surely no conclusive argument. The writer, who has had a good deal of experience with the erection and maintenance of bow trolley installations, can place as evidence against this statement the experiences of many managers of tramways in such towns as Frankfort, Mannheim, Cologne and Dresden, where, after from six to eight years, the wear on curves was not more than 1 mm. The same applies to the remark that the aluminium strip is too soft and wears away quickly. One of the two must wear, of course, and it is far cheaper to put the duty on the aluminium strip, which can be renewed at a very small cost (1s.). Also it must not be forgotten that formerly overhead wire was merely a copper bar, perhaps once drawn, but now properly drawn wire presents a much harder surface. At curves, the advantages of the bow are obvious—no side wear due to wheel flanges, no hammering by the light bow, pressing against the line with only slight pressure (about 8 to 10 lb.). The absence of hammering at the ears (only a small mechanical ear being used) does away with one of the principal causes of frequent repairs, renewals and sparking, broken wires, &c. The slight staggering of the wire is surely no objection. The time and trouble taken with the erection of the line at curves and elsewhere is much less than with a properly constructed wheel trolley line, owing to the smaller number of points of suspension, pull-offs, &c.

But the most important point raised by Mr. Eichel, is that the bow is only suitable for low-speed small power lines, and that the collecting capacity is limited to 50 amperes while running. Now, among the many towns where the bow is used, and where the average speed is higher than the average speeds we are used to over here, the writer would mention three cases, which represent the cross-country heavy service line so popular in the States.

One is the Dusseldorf-Crefeld line constructed in 1899, the Berlin to Charlottenberg line, and the line from Amsterdam to Haarlem constructed in 1905. On these lines heavy double bogey cars of the American type are used with a 500-600-volt overhead line. The maintained speeds vary between 28 miles on the Dusseldorf line to 36 miles on part of the Amsterdam-Haarlem line. It is evident that the current collecting capacity of the bows on these lines far exceeds 50 amperes per bow, and, of course, for such long cars two bows should always be used.

Recently a 1,000-volt continuous current trolley line was inaugurated between Cologne and Bonn, and that voltage is most appropriate for cross-country lines. At that voltage the limited collecting capacity of the bow completely disappears.

A reconstruction of the overhead lines in most of our large cities and the equipment of our cars with trolley bows is not such an enormous undertaking after all, seeing that a bow can run at a pinch on a line constructed for a wheel trolley. The aspect of our squares and street crossings would thereby be much improved.

CONTRACTS OPEN and CLOSED.

OPEN.

Adelaide (S.A.).—July 10th. The Postmaster-General requires tenders for 5 miles of insulated copper wire, two switchboards, two lightning arrester boards, 500 No. 2 Leclanché cells, 12 differential galvanometers, 15 electromagnetic transmitters, six plug pattern registering boxes, 500 copper tapes, 5,000 copper binders. Particulars may be obtained at the Commonwealth Offices, 72, Victoria Street, Westminster.

Belfast.—June 15th. Coal bunkers and electric travelling crane for the Corporation. See "Official Notices" May 31st.

Darlington.—Steam and exhaust pipes. See "Official Notices" to-day.

Dartford.—June 11th. Annual supplies (oils, meters, cut-outs, cable, stores, etc.) for the U.D.C. See "Official Notices" May 17th.

Dublin.—June 13th. Sub-station switchboards, transformers and accessories for the Corporation Lighting Committee. See "Official Notices" May 31st.

Eastbourne.—June 29th. Supply and erection of water-tube boiler, steam and water piping, for the T.C. See "Official Notices" to-day.

Hackney.—Tenders are to be invited for (1) the wiring, etc., of the Central Library, and (2) the purchase of discarded Worthington pumps and scrap metal.

Ilford.—June 11th. Repair and maintenance of battery for the U.D.C. See "Official Notices" May 24th.

Limerick.—June 11th. Stores for the Electricity Department. See "Official Notices" May 10th.

L.C.C.—June 11th. Electrically-operated car traversers. See "Official Notices" May 24th.

L.C.C.—June 11th. High and low-tension switchgear for five tramway sub-stations. See "Official Notices" April 26th.

L.C.C.—June 11th. High and low-tension cable. See "Official Notices" May 31st.

London, E.C.—June 24th. Electric light installation for the stage of the Central Club Society, Ltd. See "Official Notices" to-day.

London.—HACKNEY.—June 27th. Electric light installation for the Central Public Library. See "Official Notices" to-day.

London.—June 11th. The South Indian Railway Co. requires tenders by June 11th for electrical stores. Drawings (5s. per sheet), and specification (20s.), may be inspected at the offices of the company, 55, Gracechurch Street, E.C., or at that of Sir George B. Bruce, Westminster.

Manchester.—June 18th. Twelve months' supply of motors and motor-starters, meters, &c., for the T.C. See "Official Notices" to-day.

Melbourne (V.).—June 20th. Supply of 438,000 flame and 24,000 ordinary carbons. See "Official Notices" to-day.

New South Wales.—June 12th. The Postmaster-General requires tenders for 91,500 insulators, 1,800 telephones, 80 combination telephones, 85 Secrephones, 150 coin attachments, 100 junction switches, 1,000 metallic plugs, 600 switching cords, 140 miles of copper wire, and 135 tons of galvanised iron wire. Particulars may be obtained at the Commonwealth Offices, 72, Victoria Street, S.W.

Portsmouth.—June 24th. Supply and erection of 1,000-KW. turbo-alternator, with condensing plant and accessories, for the T.C. See "Official Notices" to-day.

Queensland.—June 24th. Supply of Post and Telegraph Stores. See Note in this column May 17th issue.

Servia.—The municipal authorities of Schabatz are inviting tenders until the 28th inst. for the establishment of a central electric lighting station in the town.

South Australia.—July 31st. The Postmaster-General at Adelaide requires tenders by July 31st for 12 annunciators, 2,000 Leclanché cells, 12 tubular indicators, 150 bars 4-oz. granular carbon, 784 condensers, 72 conductor cords, 1,000 receiver cords, 40 cut-outs and plugs, 12 milliammeters, 48 mouth-pieces, 96 ear-pieces, 100 receivers, 50 registers, 45 switchboards, 204 switches, five lightning arrester boards, 24 condenser telephones, 200 telephones (table sets), 500 telephones (magneto wall sets), six portable telephones, 24 transformers, four resistance boxes, 12 local sounders, 40 miles copper wire, 23 tons galvanised iron wire, 39,000 insulators, 55,000 copper pipes, 55,000 copper binders.

Spain.—Tenders have just been invited by the municipal authorities of Salvatierra de los Barros (province of Badajoz) for the concession for the electric lighting of the town.

Spain.—Tenders are being invited until the 30th inst. for the construction of an electric tramway in the town of San Sebastian.

Spain.—The municipal authorities of Deva (province of Guipuzcoa) are inviting tenders until the 16th inst. for the electric lighting of the town during a period of 10 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Deva (Guipuzcoa).

Swindon.—June 17th. Tramway tickets and punches, and advertisements on tickets and tramcars. See "Official Notices" to-day.

Walthamstow.—June 14th. Cables for the U.D.C. See "Official Notices" to-day.

Wimbledon.—June 17th. Flame arc lamps and lamp columns for the Corporation. See "Official Notices" May 31st.

CLOSED.

Accrington.—The T.C. has accepted the tender of Messrs. Callender's Cable & Construction Co. for the supply of three feeder boxes; that of Messrs. W. T. Glover & Co. for cable; and that of Messrs. Simpson Bros., of Hapton, for the electric light installation at the new library.

Barking.—The Electricity Committee has accepted the following tenders:—

British Westinghouse Co.—Rotary converters and transformers.
British Thomson-Houston Co.—Switchboards.
Western Electric Co.—Cables.

Bolton.—The Corporation Electricity Committee on May 30th accepted the following tenders:—

British Westinghouse Co.—2,000-KW. rotary converters.
Herbert Morris & Bastert.—Travelling crane.
Mr. W. Gornall.—Erection of Duncan Street sub-station.

Colne.—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the supply of a generating set, at £2,350, and for certain equipment for balancing purposes and to generate alternating current, £130; and the tender of Messrs. Galloway, Ltd., for the supply of a boiler, at £670.

Derby.—The T.C. has accepted the tender of Messrs. E. Green & Sons for economiser renewals, at £50; that of the Electric Construction Co., Ltd., for a switch panel, at £55 10s.; that of Messrs. Johnson & Phillips, Ltd., for cable, at £1,345; that of Messrs. Meldrum Bros., Ltd., for forced draught plant, £168 7s.; that of Mr. G. F. Tomlinson for the construction of the Nottingham Road tramways, £19,575; and that of the British Thomson-Houston Co. for three double-deck cars, at £592 each.

Glasgow.—The Tramways Committee of the T.C. has accepted the following offers for stores, among others:—

Axles, steel tires and steel wheels.—Glasgow Railway Engineering Co.; Brown, Bayley's Steel Works, Ltd.; John Baker & Co.; and Hadfield's Steel Foundry Co.
Chilled iron brake blocks and car-wheels.—Miller & Co.
Carbon brushes.—Le Carbone.
Rubber and asbestos goods.—Clyde Rubber Works Co.; George M'Lellan and Co.
Galvanised wires.—St. Helens Cable Co.
Vulcabeston flanges and washers for controllers.—London & Clark.
Giant strain insulators.—London & Clark.
Mica V rings for commutators.—George Schutz & Co.
Telephone repair parts.—Ericsson-Bell Telephone Co.
Motor-generator testing set.—Siemens Bros.' Dynamo Works, Ltd.
Telephone test cable.—W. T. Glover & Co.

Halifax.—The tender of the Chloride Electrical Storage Co., Ltd., to renew the storage battery at the electricity works, at a cost of £1,710 (less an allowance of £510 12s. for old material), has been accepted.

London.—The Thames Conservators on Monday accepted the tender of the Vulcan Electric Co. for the installation of electric power at the Port of London Wharf. The price was not disclosed.

BERMONDSEY.—The B.C. has accepted the tender for the supply of 500 yards paper-insulated lead-covered ·05 by ·05 by ·25 sq. in. triple-concentric low-tension cable, of Messrs. Johnson & Phillips, Ltd., at £96; and for a 20-H.P. motor for the destructor fan, that of Messrs. Crompton & Co., Ltd., at £77 5s. 8d., less £13, expenditure already incurred for 13 weeks' hire.

FULHAM.—The B.C. has, after testing samples, accepted the tender of Pestalozzi & Co. for the annual supply of carbons.

ST. PANCRAS.—The B.C. has accepted the tender of Mr. H. Tuchman for arc lamp carbons for the ensuing year, at £771 15s.

MARYLEBONE.—The B.C. has provisionally accepted the following tenders:—St. Helens Cable Co., for the supply of cables for connecting the ninth turbine with the switchboard, at £460; Messrs. W. H. Allen, Son & Co., for centrifugal pump, at £765. For this item there was only one other tender, that of the Worthington Pump Co., at £773.

ISLINGTON.—The B.C. has accepted the following tenders:—E. P. Allam & Co., electrically-driven fan for use in connection with the cooling towers, £281 10s.; Electrical Co., Ltd., annual supply of meters.

Luton.—The T.C. has accepted the following tenders for additional plant for the electricity works:—

W. H. Allen, Son & Co., Bedford.—Engine and dynamo, £2,600.
Hayward, Tyler & Co., Luton.—Pump and motor, £185.

Maidstone.—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the supply of a new engine and dynamo, at £2,850, and that of the Underfeed Stoker Co., Ltd., for a mechanical stoker, at £701.

Plymouth.—Messrs. Thermit, Ltd., have received the order for welding joints and anchoring in connection with the Mannamead reconstruction of the Corporation tramways.

Victoria.—Postmaster-General's department, 7,000 magneto telephones, wall sets, £20,912, for Melbourne; 250 ditto for Adelaide, £747, C. J. Batsam & Sons, Melbourne; 1,150 ditto for Brisbane, £3,435, Paton & Russell, Sydney; 600 ditto for Perth, £1,792, J. M. Ferguson, Ltd., Perth. Two special ear-pieces to be fitted to each of these telephones, at 1½d. each.

Weston-super-Mare.—The U.D.C. on Friday accepted the tender of Messrs. R. H. B. Neal, Ltd., of Plymouth, for an electrically-driven underground pumping installation in connection with the sewage works.

FORTHCOMING EVENTS.

Saturday, June 8th.—At 2 p.m. North of England Institute of Mining and Mechanical Engineers. General meeting at the Wood Memorial Hall, Newcastle-on-Tyne.

Thursday, Friday and Saturday, June 13th to 15th.—Meeting of the Institution of Mining Engineers at Burlington House, London. The visits include one to Park Royal generating station of the G.W. Railway.

NOTES.

Speed Regulating Shunt Resistances for Motors.—The ordinary arrangement of speed-regulating resistances for shunt motors is shown in fig. 1. In order to prevent the possibility of starting the motor with a weakened field, the starting and regulating switches should be interlocked in some way such that the starting operation can only be carried out when the full strength of field is in use. In the case of small high-voltage motors, the resistance constructed as in fig. 1 becomes an

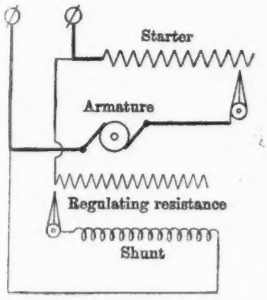


FIG. 1.

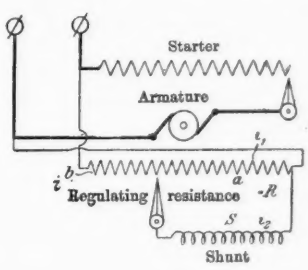


FIG. 2.

expensive item, and J. Wagner points out in a recent number of the *Elektrotechnische Zeitschrift* that a considerable reduction in cost can often be obtained by arranging the resistance as in the case of a potentiometer (fig. 2). The resistance R is here placed right across the supply voltage E, and the shunt winding S lies in parallel with a variable part a of the resistance. Using the lettering on the diagram—

$$R = a + b \text{ and } i = i_1 + i_2,$$

also $$i = E \frac{a + S}{a\,b + R\,S}, \text{ and } i_1\,a = i_2\,S,$$

or $$i = \left(\frac{S}{a} + 1\right) i_2,$$

from which a is approximately equal to $S\,R\,\frac{i_2}{E}$.

$$i_1 = \frac{S}{a}\,i_2 = \text{approximately } \frac{E}{R}.$$

In other words, the current in the part a of the resistance is approximately constant. Taking, as an example, the case of a 440-volt motor having a field resistance S = 520 ohms, a maximum shunt current of $\frac{440}{520}$ = ·85 amps. and a minimum current of ·13 amp., the regulating resistance with the ordinary connection (fig. 1) will be—

$$\frac{440}{\cdot 13} - 520 = 2{,}880 \text{ ohms.}$$

Although this carries only a small current, the mechanical arrangement will be clumsy and expensive. If the arrangement of fig. 2 is adopted, a resistance of, say, two-thirds as much (= 1,700 ohms), can be safely used.

$$R = 1{,}700,\ S = 520,\ i_2 = \cdot 85 \text{ to } \cdot 13 \text{ amp.}$$

For the maximum field current $b = 0$ and $a = R$, and

$$i = \left(\frac{S}{a} + 1\right) i_2 = \left(\frac{520}{1{,}700} + 1\right) \times \cdot 85 = 1{\cdot}11 \text{ amps.,}$$

or the total shunted current is 30 per cent. more than before. $i_1 = \frac{440}{1{,}700}$ = ·26 amp. and is almost constant. At the highest speed $i = i_1 + i_2 = \cdot 26 + \cdot 13 = \cdot 39$ amp.,

or about three times as much as in fig. 1, but this increase represents only a very small drop in efficiency. Thus, if the maximum shunt loss (at ·85 amp.) is 3 per cent. of full load, the loss with the arrangement of fig. 2 at the maximum speed will be—

$$\cdot 03 \times \frac{\cdot 39}{\cdot 85} = 1{\cdot}4 \text{ per cent.,}$$

against about ·5 per cent. with the older method. The reduction of cost will, in many cases, amply justify such a small change in efficiency.

Institution and Lecture Notes.—ELECTRICAL SURVEYORS SOCIETY.—The third meeting of this society (consisting of surveyors attached to the various fire insurance companies) was held on May 27th. Mr. A. Richardson presided, supported by the hon. secretaries (Mr. B. Chatterton and Mr. A. C. Cockburn), and upwards of 20 members. The subject for discussion was "Flexibles." After a long discussion the opinion of the meeting was taken, and it was unanimously agreed—"That the use of flexible cord in places where hard wiring in conduit or wood casing could be used, should be very strongly discouraged."

RONTGEN SOCIETY.—At yesterday's meeting a paper was to be read by Mr. A. A. Campbell Swinton on "Some Recent Investigations in Connection with Crookes Tubes." The annual report was to be presented, and the election of officers to take place.

SOCIETY OF ENGINEERS.—On Monday evening last a paper was read on "Working Experiences with Large Gas Engines," by Mr. Cecil A. St. George Moore, B.A., Camb.

ROYAL SOCIETY.—Last night the following papers were to be read:—"The Mechanical Effects of Canal Rays," by A. A. Campbell Swinton; and "On the Velocity of Rotation of the Electric Discharge in Gases at Low Pressures in a Radial Magnetic Field," by Prof. H. A. Wilson, F.R.S., and G. H. Martin.

British Motor-Boat Club.—We have received from the secretary, Mr. R. B. Robinson, Craven Hotel, Charing Cross, W.C., a copy of the programme of the club for the season. One of the objects of the club is to promote the sport of motor-boat racing, not only round the coast at such places as Cowes, Dover, Ostend, Burnham, Southsea, &c., but also on inland waters such as the Thames and the Broads. The Thames opening meeting and dinner were to be held at Nuthall's, Kingston-on-Thames station, on June 6th. One of the big events of the season, namely, the London to Cowes Race, takes place on June 22nd, and entries close on June 12th.

New Electrical Society for Liverpool.—It is proposed to start an electrical society for the purpose of lectures, discussions and social intercourse. Interested parties are requested to send a stamped addressed envelope to Mr. S. Frith, of 77, St. John's Road, Bootle, Liverpool, who will advise them of the preliminary meeting.

Electro-Chemical Notes. — ELECTROLYTIC COPPER IN RUSSIA.—According to a trade report, the recent rise in price of copper from 15 to 20 or 22 roubles per pood has greatly stimulated the electrolytic copper industry in Russia. Hitherto only some 400,000 poods have been consumed, but during the last year the amount has risen to 600,000 poods, which is approximately half the total copper consumption of the country. The amount of electrolytic copper manufactured in Russia is still very small. One factory at Penza is turning out 3,000 poods per annum, and another at Moscow about 24,000 poods. A third factory, which has been working electrolytically for some 10 years, has dealt for the last three or four years with Russian ore only. Within the last few months this factory has been increased in size, and will shortly be capable of producing 100,000 poods of electrolytic copper per annum. A fourth factory at Smejew, which was formerly treating some very low-grade ores, was closed about six years ago, as no profit could be made, but the plant is now to be brought into action again.

ELECTRICAL SMELTING OF IRON ORES.—French patents have been taken out by A. J. Petersson for a somewhat complicated piece of apparatus in which iron ores of the oxide type are to be reduced to metal partly by the aid of electricity. The plant consists of a kind of triple blast furnace, which is so fed with coal and ore that the coal forms a column in the centre of the furnace, and the ore lies at the sides. The column of coal is heated by means of two laterally disposed carbon electrodes to a temperature at which the ore is reduced to the metallic state. The carbon monoxide which is produced is drawn through the column of ore, and passes alternately to one or other of two regenerative chambers built on either side of the furnace, returning to the furnace near its base after passing through them. The metal collected on the hearth of the furnace is kept hot by an electrical induction process. In a second patent the apparatus is modified by omission of the regenerative chambers, the gases being burnt within the column of ore in the presence of air.

Calcium Carbide Works in Ireland.—A correspondent writes:—"With reference to the paragraph under the above heading appearing in your issue of 24th inst., on page 840, it is stated that:—'There are a number of water-powers in Ireland which might be used for the production of power for electro-chemical or electrothermal operations. . . . .' There are very few such water-powers of over 100 H.P., so would you please give particulars of any such operation that admits of being worked to advantage with 100 H.P."

Our correspondent is mistaken as to the magnitude of the water-powers available. The paragraph quoted related to a plant of 640 H.P., which is being doubled in size, and there are many other large powers available. Most electrochemical processes require considerably more than 100 H.P., but perhaps our readers know of some which can be carried on with this power.

Electricity in Mining.—The Maritime and Penrhiw pits of the Great Western Colliery at Pontypridd are being completely equipped with electrical plant for driving all the haulages, pumps and auxiliary machinery. At Maritime an electric winding plant is being put down capable of raising over 1,000 tons per shift, which, it is hoped, will be in working order by August. This, it is claimed, will be the first complete electrical installation, including electric winding, in this country. The Mold Collieries in North Wales are also putting down a complete electrical plant consisting of: Power station, electric haulage, and powerful electric pumps capable of pumping 4,000 gallons per minute. In both cases the collieries are acting on the advice of Mr. Gerald Hooghwinkel consulting engineer, of Westminster.

Telegraph Switching: Metropolitan Intercommunication Scheme.—With reference to this interesting scheme, which was described in our issues of May 24th and 31st last, we regret that no mention was made of the makers of the switchboard. The whole of the work, including the preliminary experiments, was carried out by Messrs. The British Insulated and Helsby Cables, Ltd., of Prescot and Helsby.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Tramway Officials.—MR. JAMES WILSON, late secretary to the Accrington Tramways Co., has been appointed general and traffic manager of the tramways under the Corporation at a salary of £200 per annum.

The Blackpool Corporation Tramway and Electricity Committee has decided to recommend the increase of the salary of Mr. CHARLES FURNESS, electrical engineer, from £520 to £600 a year, and that of MR. LANCASTER, the tramways manager, from £300 to £350.

Central Station Officials.—Mr. T. H. U. ALDRIDGE, M.I.E.E., municipal electrical engineer of Shanghai, who was in this country from March to November last year, has been awarded an honorarium of Tls. 1,500 (£217) in recognition of the work performed by him during his leave "in supervising the arrangements in England for station and plant development." Mr. Aldridge's department is, at the present time, carrying out extensions to the station which will extend it from the present capacity of 2,400 KW. to 3,600 at the end of the year, and specifications have already been sent out for an additional 800-KW. turbo-alternator, which is to be installed next year, making a total plant capacity of 4,400 KW., of which 1,200 will be for traction. In addition to this plant there is a 50-KW. motor-generator, and another of 300 KW. is now being, or has already been despatched from England. It is interesting to note that both the motor-generators are single-phase 50-cycle 2,100-volt—D.C. 500/550 volts, and are for operating on the traction load from current from the A.C. alternators. Preparations are shortly to be taken in hand for the erection of an additional power station outside the town, which will be, in the first instance, designed for 5,000 KW. turbo-driven plant.

Mr. STRIKE has been appointed acting electrical engineer to the Launceston (Tas.) City Council, at a salary of £300 per annum, and Mr. GEO. MCELWEE sub-station and test-room electrician at a salary of £150 per annum.

The following staff changes in the Halifax Corporation Electricity Department have been recommended: Mr. E. G. LOVE as assistant engineer, and Mr. ERNEST PRIESTLEY as steam plant engineer.

The Belfast T.C. on the 3rd inst. unanimously approved the appointment of Mr. T. W. BLOXAM as city electrical engineer.

The directors of the Great Eastern Railway have recently appointed Mr. H. W. FIRTH as electrical engineer to the company. Up to the present time Mr. Firth has been responsible (under the engineer of the company), for the electric lighting and power works, including the designing and carrying out of the new Stratford power plant, which has just started work. He will take over the telegraph department, in addition to the electric lighting and power installations, thus forming one comprehensive electrical engineering department of this important railway.

The staff of the Colchester Corporation electricity works on Saturday, presented a travelling bag to Mr. F. H. HUMPHREY, assistant engineer, who is leaving to take charge of the electric light installation at the "White City," Manchester.

To commemorate the event of Mr. W. J. WILLIAMS's wedding, a smoking concert was held at the "New Herrington" Hotel on May 29th, when he was presented by Mr. Alington Johnston with a sectional bookcase and a silver cigarette case, suitably inscribed (these on behalf of the staffs of the Durham Collieries Electric Power Co., and the Newcastle-on-Tyne Electric Supply Co., &c.); a tantalus stand was also presented by the engineers-in-charge of the Lambton power station, after which a select programme of music was rendered.

Mr. FRED WILLIAMS, mains foreman for the past four years at Hornsey, was last week presented by the staff of the electricity department with a pendant barometer. Mr. Williams, who goes South to engage in private enterprise, carries with him the good wishes of the staff.

General.—MR. JOHN MAY, M.I.C.E., M.I.E.E., and Mr. G. W. SPENCER HAWES, M.I E.E., announce that their connection with the firm of Messrs. Robert Hammond & Son having been terminated by mutual consent, they are now practising under the style of May and Hawes, at Caxton House, Westminster. Messrs May and Hawes' experience in the design, construction and administration of electrical undertakings extends over a period of 17 years, and they are prepared to deal in a consultative capacity with all classes of electrical engineering work; we wish them every success in their venture.

Mr. JOS. H. EVANS, of Manchester, has been elected chairman for the ensuing year of the Manchester Branch of the Electrical Contractors' Association.

At the Oxford Commemoration on the 26th inst., the honorary degree of D.Sc. will be conferred upon Sir W. RAMSAY, Sir W. H. PERKIN, and Dr. LUDWIG MOND, amongst other well-known scientists.

Obituary.—The death occurred, on May 29th, at the age of 66 years, of MR. EDWIN REED BARRETT, chairman of Messrs. Baily, Grundy & Barrett, Ltd., electrical engineers, of Cambridge.

NEW COMPANIES REGISTERED.

Société d'Exploitation des Forces Motrices de l'Aveyron, Ltd. (93,494).—This company was registered on May 25th, with a capital of £26,000 in £4 shares, to acquire a concession granted by the Commune of Cordes (Tarn), France, belonging to Gabriel Dirit and P. Gadaud, trading as Dirit & Compagnie, and relating to the public and private electric lighting of the same Commune, pursuant to an agreement, date June 20th, 1905, approved by the Prefet of the Department du Tarn, all the rights under such agreement being made over to the company by way of "apport," to transfer the hydro-electric factory at Contillon at La Guepie (Tarn et Garonne), with its existing appurtenances, the high and low tension lines, the tunnelling and the transformers of the town of Cordes, at the present the property of the concession aires, pursuant to the said agreement, to work the said concessions for the electric lighting of Cordes and its environs, to work a flour mill to be erected at La Guepie, and to carry on all commercial, industrial, financial and other operations relating to the working of the same at La Guepie or elsewhere, &c. The first subscribers (each with one share) are:—P. Braby, 5, Arundel Street, Strand, solicitor; J. R. Virslet, 21, Rue le Pelcher, Paris, avocat; A. M. Walker, 5, Arundel Street, Strand, W.C., solicitor; J. O. Stacey, 5, Arundel Street, Strand, W.C., solicitor; G. A. Macdonald, 5, Arundel Street, Strand, W.C., solicitor; W. E. Game, 5, Arundel Street, Strand, W.C., clerk; and Miss E. P. Harrison, 20, Prince of Wales' Mansions, Battersea Park, S.W. No initial public issue. The number of directors is not to be less than five or more than nine; the first are G. Dirit (managing director and technical director, as regards the carrying on of the electrical factory and flour mill); L. Daudibertieres (manager of electrical department); L. Descubes (manager of flour mill); and others to be appointed by the subscribers; qualification, £20: remuneration, 10 per cent. of the profits when 6 per cent. dividend is paid, and £1 each per board meeting attended.

Cutler, Wardle & Co., Ltd. (93,564).—This company was registered on June 1st, with a capital of £5,000 in £1 shares (2,000 preference), to acquire the business carried on by W. Wardle, at 35 and 37, Dickinson Street, and Haig's Buildings, Hargreaves Street, Manchester, to adopt an agreement with W. Wardle, and to carry on the business of electrical, heating, ventilating and mechanical engineers, builders, contractors, manufacturers of agricultural implements and other machinery, &c. The first subscribers are:—W. Wardle, Rowsarden, Errwood Road, Levenshulme, Manchester, electrical engineer, 1 share; E. Gardner, 6, Kedleston Avenue, Victoria Park, Manchester, secretary, 500 shares; H. Wardle, Rowsarden, Errwood Road, Levenshulme, Manchester, electrical engineer, 1 share; A. O. Wardle, Rowsarden, Errwood Road, Levenshulme, Manchester, electrical engineer, 1 share; A. G. Mellors, 18, Exchange Street, Manchester, chartered accountant, 1 share; G. A. Mitchell, 275, Woodborough Road, Nottingham, clerk, 1 share; and A. L. Berrey, Clumber Road, The Park, Nottingham, lace manufacturer, 1 share. No initial public issue; the number of directors is not to be less than two or more than seven; the first are W. Wardle (chairman) and G. Gardner; qualification, 100 shares. Registered office, 35 and 37, Dickinson Street, Manchester.

Universal Electrical Supply Co., Ltd. (93,507).—This company was registered on May 27th, with a capital of £1,000 in £1 shares, to carry on the business of electrical and mechanical engineers, suppliers of motive power, manufacturers of, and dealers in, electrical apparatus, &c., and to adopt agreements with A. Poad and G. F. Hewlett respectively. The first subscribers are:—H. J. Coward, 58, Elton Road, Bristol, accountant, 1 share; A. Poad, 55, Queen Square, Bristol, foreign importer, 595 shares; G. F. Hewlett, 67, Wine Street, Bristol, electrical engineer, 400 shares; W. S. Mossman, 57, Arley Hill, Cotham, Bristol, photographer, 1 share; A. E. Hewlett, 26, Landsdown Road, Redland, Bristol, electrical engineer, 1 share; A. V. Garland, 49, Elton Road, Bristol, electrical engineer, 1 share; and Lillie Poad, 55, Queen Square, Bristol, clerk, 1 share. No initial public issue. The number of directors is not to be less than three; the first are A. Poad (chairman), G. F. Hewlett and A. E. Hewlett. Registered office, 55, Queen Square, Bristol.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Northern Counties Electricity Supply Co., Ltd. (67,924).—This company's annual return was filed on May 7th, when 150,000 shares (including 10 forfeited) had been taken up out of a nominal capital of £200,000 in £1 shares; £1 per share has been called up on 146,000, and £145,991 5s. has been received, leaving £8 15s. unpaid on the forfeited shares; 4,000 shares are considered as fully paid. Mortgages and charges: £100,000.

Korting Bros., Ltd. (78,308).—This company's annual return was filed on April 12th, when the entire capital of £50,000 in 10,000 £5 shares had been taken up. £1 10s. per share had been called up and £15,000 has been received. Mortgages and charges: Nil.

Browett, Lindley & Co., Ltd. (63,128).—This company's annual return was filed on April 13th, when the entire capital of £120,000 in 60,000 preference and 60,000 ordinary shares of £1 each had been taken up; £1 per share has been called up on 42,000 preference and 23,478 ordinary, and £65,478 has been received; £34,522 is considered as paid on 8,000 preference and 26,522 ordinary. Mortgages and charges: £30,000 debenture stock.

Bergtheil & Young, Ltd. (83,061).—This company's annual return was filed on April 10th, when 32,007 shares had been taken up out of a nominal capital of £40,000 in £1 shares. £8,007 has been received, and £24,000 is considered as paid. Mortgages and charges: Nil.

Electric Supply Co. of Victoria, Ltd. (Liverpool), (66,059).—A trust deed dated May 9th, 1907, to secure a further £40,000 5 per cent. redeemable debenture stock (supplemental to a trust deed dated July 7th, 1905, securing £160,000 debenture stock) has been registered. The present series ranks *pari passu* with the £160,000 secured by the deed of 1905. Property charged: Certain tramway and lighting orders, all benefit under any Victorian Act or Order, all freehold and leasehold property of the company in Victoria, and the company's undertaking and property, present and future, including uncalled capital. Trustees: Executors' and Securities Insurance Corporation, Ltd., Winchester House, E.C.

Electrolytic Alkali Co., Ltd. (Middlewich) (64,360).—Issue on May 13th of £150 4½ per cent. first mortgage debentures, part of series created July 9th, 1904, to secure £50,000, charged on the company's undertaking and property, including uncalled capital. Trustees: Liverpool Mortgage Insurance Co., Ltd., 6, Castle Street, Liverpool. Previously issued of same series: £30,950.

"X" Electric Accumulator Co., Ltd. (London), (85,174).—A debenture dated May 16th, 1907, to secure £2,500, charged on the company's undertaking and property, present and future, has been registered. Holder: J. A. Blackley, 34, Sloane Court, S.W.

National Electric Construction Co., Ltd. (53,364).—A trust deed dated May 7th, 1907, to secure £75,000 debentures, authorised by resolution of the company dated May 6th, and resolution of the board dated May 7th, 1907, has been registered. Property charged: Certain shares in the Mexborough and Rawmarsh Construction Syndicate, Ltd., and the Torquay Tramways Construction Syndicate, Ltd., certain shares and debentures in the Musselburgh and District Electric Light and Traction Co., Ltd., the company's interest in certain contracts, a sinking fund policy for £75,000 in the Legal and General Life Assurance Society, and the company's undertaking and property, present and future, including uncalled capital. Trustees: L. B. Schlesinger, 21, Cornhill, E.C.; and R. Williams, Norfolk House, Victoria Embankment, W.C.

Mawdsley's, Ltd. (electrical engineers, Dursley), (91,783).—£5,000 4½ per cent. debentures, created and dated May 27th, 1907, charged on the company's property, present and future, including uncalled capital, have been registered. No trustees.

A. B. P. Accumulator Co., Ltd. (Stockton), (76,438).—A memorandum of satisfaction in full of second mortgage debentures dated March 20th, 1903, securing £10,000, has been filed.

Electrical Installations, Ltd. (91,050).—This company's annual return was filed on May 14th, when 2,307 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £1 per share has been called up on 107, resulting in the receipt of £107. 2,200 shares are considered as fully paid. Mortgages and charges: £1,500 5 per cent. debentures.

City of Oxford Electric Tramways, Ltd. (91,106).—This company's annual return was filed on April 3rd, when 7 shares had been taken up out of a nominal capital of £150,000 in £1 shares. Nothing has been called up. Mortgages and charges: Nil.

Arnold Goodwin & Son, Ltd. (81,633).—This company's annual return was filed on May 3rd, when 5,307 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £1 per share has been called up on 307 shares, resulting in the receipt of £307. 5,000 shares are considered as fully paid. Mortgages and charges: £5,000.

Direct Spanish Telegraph Co., Ltd. (6,732).—This company's annual return was filed on April 12th, when 12,981 ordinary and 6,000 preference shares had been taken up out of a nominal capital of £95,000 in £5 shares (6,000 preference and 13,000 ordinary shares). £5 per share has been called up, resulting in the receipt of £94,655. Mortgages and charges: £30,000 4½ per cent. first mortgage debentures and £16,000 4½ per cent. second mortgage debentures.

Hove Electric Lighting Co., Ltd. (36,942).—This company's annual return was filed on April 10th, when 15,060 shares had been taken up out of a nominal capital of £100,000 in £5 shares. £5 per share has been called up, resulting in the receipt of £75,000. Mortgages and charges: £44,600.

CITY NOTES.

Elmore's German and Austro-Hungarian Metal Co., Ltd.

The directors' report just issued deals with the accounts of the above company and of the Metall Co. for the year ending December 31st, 1906. The income of the company from all sources is slightly larger, being £8,778, as against £8,417 in 1905, which, after paying all charges for the year, leaves the sum of £268 to be carried forward, as against £176 last year. Since the end of the financial year the debenture stockholders have agreed to postpone redemption of the stock until the 1st of July, 1912, the company retaining power to redeem at an earlier date by paying 2½ per cent. premium. The stockholders have also agreed to the bankers of the Metall Co. having a charge for M. 1,000,000 (£50,000) in priority to the mortgages held by the trustees for the debenture stockholders. In order that the right of the stockholders should be safeguarded, the trustees required that the consent of the Court should be first obtained to the proposal, and such consent was duly given. The directors regret that their efforts to carry through a re-arrangement of the debenture debt of the company were abortive; the high rate of interest, coupled with complete security, being evidently so satisfactory that the debenture stockholders were unwilling to make an alteration. The year 1906 proved to be disappointing so far as the Metall Co. was concerned, and had it not been for improvements in manufacture which considerably reduced the cost, the trading profit would have been less than that made in 1905, whereas it is larger. The abnormally high price of copper necessitated more working capital, while the high Bank Rate rendered the borrowing of money very costly, with the result that £700 more was paid for interest than in the previous year; wages cost £2,000 more in 1906 than in 1905, and the cost of materials increased. The demand for the Metall Co.'s products continues, and orders for a large amount are in hand, while the sales from January 1st, 1907, to date show a large increase compared with the same period last year. The sum of M. 87,233 (say, £4,361) has been charged to revenue on account of depreciation, repairs and maintenance, an increase of over £600 on the same item last year, while the sum of M. 80,674 (say, £4,033) was expended on capital account for additions to buildings, plant, &c. The directors believe that even under the abnormal conditions now existing the trading profit for the present year will show a considerable improvement over that of last year.

The general meeting of the company will be held at Finsbury House on June 13th, when the following resolution may be submitted, with or without amendment:—

"Resolved: That notwithstanding anything to the contrary contained in the special resolution of the company passed on March 12th, 1894, and confirmed on March 30th, 1894, the holders of the existing 75,000 preference shares of £1 each in the capital of the company shall, in the event of the winding-up of the company, be entitled to receive in full out of the available assets of the company, the amount for the time being credited as paid up on such preference shares, in priority to any payment to the holders of the existing 162,981 ordinary shares of 5s. each in the capital of the company, after which the available assets shall be applied so far as the same will extend in payment to the respective holders of all the ordinary shares on which the full sum of 5s. per share shall for the time being be credited as paid of the sum of £2 per share, and to the holders of any of the said ordinary shares on which a less sum than 5s. per share shall be credited as paid, of such a sum per share as shall bear the same proportion to £2 as the amount so credited as paid up thereon shall bear to 5s. And any surplus assets of the company remaining available for distribution shall be divided amongst the holders of the said preference and ordinary shares in proportion to the number of shares of either class held by them respectively."

British Aluminium Co., Ltd.

The twelfth ordinary general meeting of this company was held on Tuesday at Winchester House, Mr. J. D. Bonner presiding.

In moving the adoption of the report (Electrical Review, May 31st, page 895), the Chairman said that during the past year the company had earned the handsome profit of £155,023, the largest ever produced in any year of the company, and he felt confident that they would regard it as very satisfactory. They had also been enjoying equal prosperity in the current year. They had spent £29,328 of that sum in redeeming some debenture stock and payment of interest on that stock. They had redeemed £50,000 debenture stock during the last three years, leaving £250,000 outstanding, and they had also purchased and cancelled 3,455 Funding certificates at £14,534. They proposed again to write off £20,000 for depreciation. After providing for interest on the shares, which would absorb £32,891, they would carry forward £34,548, as against £3,880 a year ago. No dividend had been paid on their large holding in the Loch Leven Water and Electric Power scheme, notwithstanding that that company was empowered to pay 3 per cent. during the construction of its work. They hoped, however, that next year they would begin to derive some benefit from the large expenditure that had been incurred. They had during the year made progress with the Loch Leven scheme. They were, however, somewhat handicapped, owing to the scarcity of men. Sir John Jackson, the engineer, had informed him that they could give continuous employment to 1,500 men for several months, and it was a matter of disappointment to them that they could not get that number. They expected to have finished the works at Loch Leven by August, 1908, and if the generating plant, machinery, &c., was ready by then, the factory could soon be put in working order. They had provided accommodation for some 1,200 persons at Kinlochleven, which was a population equal to that of Dunstable. A great power scheme like that necessarily took some time to complete, and they had in consequence obtained possession of a partially developed power at Stangfjord, in Norway, and had taken steps to develop some power at Loch Leven without interfering with the main scheme. Those minor matters had been designed by Mr.

Murray Morrison, who, together with Lord Kelvin, had been appointed technical adviser to the company. They expected to start manufacturing aluminium in Norway next month and at Leven in September. Owing to the great progress that had been made by aluminium manufacturing companies, he expected that the output all over the world would so largely increase in the near future, that a lower price for the article was almost a certainty. They, however, looked forward to such a reduction with equanimity, as they believed it would tend to an increased demand for the article. The high prices that had ruled for aluminium had undoubtedly restricted its use, and now that they had so much more metal to dispose of, their business would be placed on a more level and sounder basis by the return to a lower price. They had acquired concessions for a water-power of considerable magnitude at Orsieres, in Switzerland. When they did that, and when they acquired the power in Norway, they were not aware that the first directors of the company in 1895 received certain information as to the manufacturing of aluminium from the Neuhausen Co., upon condition that the information was only used in the United Kingdom and the Colonies. The Neuhausen Co. had therefore opposed their starting works in Norway and Switzerland, or, in fact, anywhere abroad, but the matter had been satisfactorily arranged. The Orsieres scheme they regarded as a thoroughly sound one, and they anticipated that the capital cost per horse-power developed would be less than that at Loch Leven. They thought they would have no difficulty, in view of the steady expansion of electro-chemical industries, in arranging for a profitable utilisation of their power when it became available; they therefore intended to proceed as quickly as possible with the development of the power. The conversion shares, which would be created for the extension of the company, would be allotted on the 11th prox. to the registered shareholders, and he had no doubt but that they would be readily subscribed, especially as many of the large shareholders had informed him that they intended to accept allotments.

Mr. H. WOLFENDEN seconded the motion, and the report was acopted unanimously.

The Birmingham and Midland Tramways, Ltd.

THIS company's report, which was presented at the general meeting on the 6th inst., shows that the total revenue for the year amounted to £92,582 compared with £116,643 in the preceding year, but the latter amount included £12,956, the receipts of the omnibus department for the five months ended May 31st, 1905, when this department was transferred to a separate company. The expenses for the year amounted to £44,952, compared with £74,465 for 1905 (including £14,453 expenses of the omnibus department for five months). After providing for all expenses chargeable to revenue, including rents, repairs and maintenance, and £2,500 placed to depreciation and renewals account, and adding the £573 brought forward from the last account, there remains £48,203, from which is deducted interest on the debenture stock £14,113, and dividend on the preference shares £11,538, leaving £22,552. From this amount the directors propose to place to the debenture redemption fund £2,750; to pay a dividend on the preferred ordinary shares at the rate of 5½ per cent. for the year ended December 31st, 1906, £19,250; and to carry to the next account £552.

The expenditure on capital account during the year amounted to £7,764. An issue of £80,000 4½ per cent. first mortgage debenture stock was made during the year, ranking *pari passu* with the stock previously issued, to discharge balances payable on contracts in connection with the reconstruction and equipment of the company's lines, and for other purposes. The amount of stock now issued is £355,000. As provided by the trust deed, a sum equal to 1 per cent. of the stock issued was paid to the trustees in July last, and was applied by them in the purchase and cancellation of £2,763 of stock.

The gross receipts from the tramways for the year amounted to £58,081, which, compared with the previous year, is £24,000 less, due chiefly to the termination on June 30th, 1906, of the lease of the Dudley Road Tramway in Birmingham, and to the previous inclusion of omnibus receipts. The expenses have decreased by £29,500. The receipts from the lighting and power departments amounted to £7,343, or £800 less than in the previous year, due to the loss of the supply of energy for the working of the lines in Birmingham, subsequent to June 30th. The expenses of this department were £5,129, or £1,906 less than in 1905. The interest and dividends received from investments amount to £25,843, compared with £24,565 for 1905.

As regards the tramways within the city, the leases from the Birmingham Corporation expired on June 30th last, when the lines were surrendered; but by arrangement, through services from Dudley, Oldbury and Smethwick into Birmingham are fully maintained. By agreement the overhead lines and low tension cables on these tramways were purchased by the Corporation for £6,560, and a sum of £2,250 was received in respect of the reconstruction of the Dudley Road line, which sum has been carried direct to profit and loss account. The company still owns the leasehold sub-station at Springhill, the plant therein and the cable ducts within the city. Arrangements are being made for disposing of these properties.

As regards the tramways outside the city, the price of £10,631 fixed by the arbitrator as the value of the company's tramways in Dudley has not yet been paid by the Corporation, pending an appeal which has been taken by the Corporation to the House of Lords on the question of the price to be paid for Railway No. 5. The tramways about to be purchased will subsequently be leased to this and the other associated companies for 21 years, on terms to be agreed. All outstanding matters with the Rowley Regis Council have been settled, and a lease of the tramways in Rowley Regis, constructed under the Birmingham and Midland Tramways Act, 1902, has been granted for a period of 30 years from November 9th, 1904. By agreement the tramways in Smethwick were leased to the company for a period of 21 years from August, 1902; and the company were enabled to supply light and power under the Smethwick Electric Lighting Order of 1898. The Board of Trade, having declined to approve that agreement, a fresh one has now been executed, which provides for a lease for a period of 35 years from 1902, at an increased rental. The section of tramway in Bearwood Road, Smethwick, constructed by the company under the Act of 1902, is worked in connection with the Dudley Road main line jointly by the Corporation of Birmingham and the company, the receipts in each area belonging to the owner of the line. An arrangement has been made whereby the short section of tramway in Soho Road, being a continuation of the Heath Street line, is worked for the company by the Corporation, the receipts taken by the Corporation cars being paid to the company after deduction of expenses.

By the agreement dated October 31st, 1901, above-mentioned, the company undertook to supply light and power in Smethwick under the Smethwick Electric Lighting Order of 1898. As the Board of Trade were unable to approve the original agreement for light and power supply in Smethwick, fresh terms were arranged with the Corporation for the transfer of their order to the company, and an agreement for carrying out the transfer has been executed and submitted to the Board of Trade for their approval. The supply of energy to power and lighting consumers in Smethwick has made considerable progress during the year; the connections to the mains on December 31st of each year, in the equivalent of 8-C.P. lamps, were as follows:—

	1905.	1906.
Lighting	1,679	3,940
Power	2,638	8,956
Tramways	35,000	25,000
	39,317	37,896

The management of the company's undertaking by the Birmingham and Midland Tramways Joint Committee continues to show satisfactory results, and further economies have been effected in several departments during the past year. A joint car-shed and workshops at Tividale, near Dudley, for all the companies operated by the Joint Committee is now in full operation; this has enabled the workshops at the West Smethwick and Darlaston depôts to be closed. The parcels and goods traffic has been carefully developed during the past year, and has shown very satisfactory results. The registered offices of the company have been transferred from Central House, New Street, Birmingham, to Donington House, Norfolk Street, Strand, London, W.C. Mr. C. S. B. Hilton and Mr. S. R. Blundstone are the directors to retire by rotation, and, being eligible, offer themselves for re-election: Messrs. Howard Smith, Slocombe & Co., the auditors of the company, also retire, and offer themselves for re-election.

The following particulars relate to the company's tramways:—

	Year ended Dec. 31st, 1905.	Year ended Dec. 31st, 1906.
Miles open—Route miles ...	14·65	12·10
Single line	6·07	5·41
Double line ...	8·58	6·69
Number of passengers carried ...	15,579,914	13,255,130
Average receipts per passenger ...	1·07d.	1·05d.
Average expenditure per passenger (apart from rent of line, &c.) ...	·65d.	·58d.
Proportion of expenses to receipts	61 %	55 %
Number of cars in stock... ...	61	61

Rio de Janeiro Tramway, Light and Power Co.

THE first annual report, extracts from which appeared in the financial papers of 31st ult., states that the directors had decided to develop the Rio das Lages water-power first, and to hold the Rio Parahyba in reserve, although at the time of coming to this decision it was believed that the Rio das Lages was only capable of developing 40,000 H.P., whilst the Sapucaia power can easily develop 100,000 H.P. in the driest season. The clearing of the banks of the Rio das Lages has disclosed that the reservoir formed by the dam which the company is building at Rio das Lages will have a much larger capacity than was anticipated, and consequently a much greater power can be developed, and by a recent concession the company have acquired the right, if and when they desire, to tap the neighbouring watershed of the Rio Pirahy, which will ensure sufficient water to develop a total of 120,000 H.P. at Rio das Lages in the driest season. The directors deemed it advantageous immediately to construct at Rio das Lages a preliminary hydro-electric plant, and power from this source was made available for use within the city of Rio de Janeiro during March, 1907. This plant has a capacity of 3,400 H.P., and will be utilised for furnishing all the lighting and power required for the construction work at Rio das Lages, as well as for supplying light and power in Rio de Janeiro over the permanent transmission lines which are already completed. Meanwhile the main installation at Rio das Lages is being rapidly constructed. A concrete and masonry dam is being built at the top of the falls, 115 ft. in height and 92 ft. in thickness at the base. This structure will impound sufficient water to guarantee under the present development a maximum load of at

least 50,000 H.P. It is hoped that the first generator will be at work during the summer, and all six before the end of the year. The company has from time to time acquired the control of almost all shares in the following companies:—Sao Christovao, Carris Urbanos, Villa Isabel, Tijuca, Cocovado, Gas de Rio de Janeiro, Brazilianische, Elektricitäts Gesellschaft (Telephone Co.). The company has also acquired the control of nearly 11,000 out of 25,000 shares, and the whole of the debentures of the Carioca Tramway Co. The tramways controlled by the company operate about three-fourths of the total tramway mileage of the Rio. In every case the concessions of the above tramway companies are exclusive, each within its own zone, and cover the business centre of the city, and, with one exception, all of the important suburbs. The Sao Christavao concession expires in 1950, the Villa Isabel in 1945, the Tijuca in 1940, the Cocovado in 1932, and the Carris Urbanos in 1930. The gas company concession expires in 1945, and is exclusive for private gas and for street lighting by electricity or gas until 1945, and for private electric lighting until 1915. The telephone concession granted in 1898 is absolutely exclusive for the whole federal district until 1928, when it expires. It is not possible to give definitely the earnings of the combined undertaking for the year 1906, as the various properties have been acquired and gradually brought under the company's control during that year. A close estimate, however, has been made as follows:—Gross, $5,575,000; working expenses, $4,010,000; net, $1,565,000; percentage, 72. The earnings of the first three months of the current year have been at the annual rate of:—Gross, $5,583,748; working expenses, $3,775,000; net, $1,808,748. The directors look on the future of the undertaking with complete confidence. All their anticipations have, up to the present, been entirely justified, and they consider that, with the completion of the hydro-electric installation at Rio das Lages and the delivery of further power from that source, for which they already have a large number of customers waiting, the earnings of the company will be largely increased; and basing their calculations on their long experience of electrical enterprises, and especially on their intimate knowledge of the working of the Sao Paulo Tramway Co. of Brazil, the conditions governing which are almost entirely identical with those governing this company, they are entirely confident that the profits of the company will enable them to pay regular and satisfactory dividends on the stock.

Callender's Cable and Construction Co., Ltd.

THE eleventh annual general meeting of this company was held on Thursday of last week at Hamilton House, Victoria Embankment, Mr. HENRY DRAKE presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, May 17th, page 816), said that when he addressed them last year, he stated that he had to submit accounts of the most prosperous year the company had ever had, but he was glad to say that the accounts now presented showed an advance of about £2,000 even on last year's figures. The profits for the year, after deducting charges for manufacturing account and contracts, including taxes, salaries, &c., at Erith, were £122,925, as compared with £124,541 last year. Against that sum they had to set the general expenses amounting to £28,835, leaving a balance of £80,773, as against £79,094 in the previous year. To that sum they had to add the balance brought forward, £38,921, making a total of £119,695. They had to deduct the interest on debenture stock £13,500, dividend on preference shares £10,000, appropriation for depreciation of buildings, plant and machinery £12,866, and appropriation for depreciation on office furniture £356, in all a total of £36,723, leaving an available sum of £82,972. They proposed to deal with that by the payment of a dividend on the ordinary shares of 10 per cent. clear of income-tax, being 10s. per share, of which 5s. was paid on November 1st, 1906, and 5s. would be paid on May 31st, which would absorb £17,500; the payment of a 5s. per share bonus, £8,750, and to carry forward £56,722. He, therefore, thought that the results were very satisfactory.

Mr. MCEWEN seconded the motion.

Mr. T. O. CALLENDER said he thought they would all agree that the past year had been a very satisfactory one, but it had been a very trying period both to the managers and the directors. They had had great difficulty in maintaining their position, through various causes. No money had been available for new works, and that difficulty was still with them, and possibly in a more acute form than last year. They had also had during the past year legislative proposals for the supply of electricity in bulk for London and elsewhere, and that had considerably influenced electrical companies against starting new undertakings or extending existing works. The price of copper had also greatly advanced. Whereas in the middle of last year it was £84 and £85 a ton, at the end of the year it was £115, an advance of £30, or nearly 50 per cent., and it had, therefore, been very difficult to secure contracts, but in spite of all their difficulties they had not done badly. The English trade had been poor, and the trade that had been done had been in extending existing works rather than in new enterprises, but owing to the network of cables now, that required extending, the work of extension in itself amounted to no insignificant figure. They had devoted their attention very largely to foreign work, and in doing so they had endeavoured to hold their own in a most efficient manner. They had not confined themselves to writing letters and appointing agents, but they had gone themselves. He had just returned from India, Mr. James Callender had returned from Canada, another representative had been on a long trip to South America, and Mr. Peterson had journeyed to all parts of the Continent with a view to extending their operations; their manager in India was leaving for China and Japan so as to endeavour to secure contracts. The shareholders would, therefore, see that wherever cables were likely to be used the company was fighting its battles in a very satisfactory manner, and doing its best in common with other companies to secure contracts. Whatever the result would be they had done their best to secure success, and he hoped they would obtain it. Their business was extending, and this was especially so in India where they had a very vast business opening up, which would, he hoped, before very many years had passed be a source of profit to them. Another difficulty that had stood in their way was the power companies. They believed that there was an immense future in the supply of electricity in bulk. Circumstances had arisen which had rendered it difficult to obtain money for new works, and they had suffered to a certain extent in their turnover, by reason of the stoppage of business which they anticipated. They had met the difficulty by writing down out of the profits the shares held by the company, and the directors were convinced that what they now stood at in the company's books was a fair and proper valuation. A complete inventory had been taken of the assets and property of the Anchor Co., and the figure at which they now stood—£74,000—was the fair and proper value of that investment. That company was now doing well and making a profit. The policy that had been pursued by the board in regard to the St. Helens Cable Co. was they thought an entirely satisfactory one, and to the interests of the company. Although the amount spent on the works at Erith was a little less this year, the works were in first-class order. With regard to the prospects for the current year, they would do all they could to keep their business up to that high state of efficiency in which it had been maintained in the past, but whether they would be able to do so depended upon the state of the money market. He hoped there would be an improvement in that respect, so as to allow new works to be taken in hand, and he hoped also that the condition of the copper market would improve. Although that was the eleventh year of the company's existence it was really the 25th year of the operation of the business, and the original shareholders had received in dividends 325 per cent. on their money during the 25 years, and the shareholders in the present company 157 per cent. during the eleven years of the company's work.

The report was adopted.

Rubber Estates of Ceylon.—The second annual general meeting was held on Thursday last week, Mr. C. E. Strachan presiding. The chairman, in moving the adoption of the report, said that they had been able to make a revenue from the tea, cocoa, and plumbago they had sold, and to pay a dividend of 3 per cent. Up to the present nothing had been available from rubber. At the end of 1906 they had an area of 2,368 acres planted with rubber, and in the current year it was expected that they would open about 580 acres of forest land. It was probable that the yield of all the estates would be limited by the amount of labour that was obtainable.

General Electric Power Co.—According to *South Africa*, a meeting of the company was held on April 30th, at Johannesburg, when the chairman, Mr. R. G. Fricker, explained that in January last the shareholders sanctioned the sale of the assets of the company to the African Concessions Syndicate, and the purchase of 100,000 £1 preference shares in the Victoria Falls Concessions, Ltd. The transfers had been passed and registered, and it only remained to place the company under liquidation. The resolution was carried.

Switzerland.—La Société Franco-Suisse Electrique, of Zurich, reports a profit of £51,173 for the last financial year.

France.—The balance-sheet of La Compagnie d'Electricité Thomson-Houston de la Mediterranée for the last financial year shows a profit of £34,043.

Egypt.—La Compagnie Egyptienne Thomson-Houston is the name of a company which has just been formed in Brussels, with a capital of £200,000, to develop the Thomson-Houston electrical interests in Egypt.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended April 26th, 1907, were 511,662, compared with 497,922 units in the corresponding four weeks of 1906.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Sao Paulo Tramway, Light and Power Co., Ltd.—10,000 additional shares of $100 each of capital stock.

And to allow the following to be officially quoted:—

Sao Paulo Tramway, Light and Power Co., Ltd.—$500,000 additional 5 per cent. mortgage debentures of $500 each, Nos. 11,001 to 12,000.

Prospectus.—During this week the subscription list has been open for £200,000 4½ per cent. debenture stock, issued by the Shawinigan Water & Power Co. The list closed yesterday.

Craigpark Electric Cable Co., Ltd.—The profit for the past year amounted to £6,443, as compared with £4,823, the three previous years' average. With the balance of £911 brought forward, £7,354 was disposed of as follows: Usual dividend on preference shares; £1,000 to depreciation; £700 to preliminary expenses; 6 per cent. dividend, ordinary shares; and £1,154 carried forward.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open.	Inc.
Aberdeen	May 31	3,111	+ 332	52	71,779	+ 2,124	14·4	..
Ayr	June 1	583	+ 6	3	704	— 8	8	..
Bath	May 29	2,086	+ 524	22	15,920	+ 542	13	..
Belfast	,, 31	7,6?3	+ 802	9	31,938	+ 2,124	40	..
Birkenhead	June 2	2,101	— 6	9	9,162	— 318	13·52	..
Birmingham Corp.	,, 1	12,730	..	9	53,C8?	..	56·15	..
Blackburn	May 29	2,400	+ 579	9	10,675	+ 1,239	23·8	..
Blackpool Corp.	,, 30	3,490	+2,308	..	7,700	+ 1,485	11·87	..
,, —Fleetw'd.	June 1	2,222	+1,441	21	8,104	+ 744	8·25	..
Bolton	,, 2	5,802	+1,235	9	20,264	+ 1,342	26	..
Bournemouth	May 29	3,648	+ 808	8½	14,417	+ ?61	21·5	2·75
Bradford	June 1	9,714	+1,234	9	41,419	+ 1,909	53	..
Brighton	,, 3	2,032	+ 220	9	7,986	..	9·5	..
Bristol	May 31	11,490	+1,669	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	,, 24	465	+ 19	20	4,489	+ 18	3·65	..
Barnsley	,, 24	382	+ 64	,,	3,280	+ 4	..	..
Barrow	,, 24	557	+ 101	,,	4,600	+ 110	5·37	..
Cavehill	,, 24	193	+ 30	,,	1,473	+ 77	..	..
Devonport	,, 24	969	+ 63	,,	8,947	+ 203	8·85	..
Gateshead	,, 24	2,104	+ 241	,,	19,956	+ 891	11·25	..
Gravesend	,, 24	571	+ 109	,,	4,611	+ 230	6·5	..
Greenock	,, 24	1,441	+ 39	,,	12,725	+ 178	7·25	..
Hartlepool	,, 24	645	+ 105	,,	5,261	— 151	6·72	..
Kidderminster	,, 24	329	+ 120	,,	2,091	+ 69	..	..
Leamington	,, 24	402	+ 106	,,	2,935	— 15	3	..
Merthyr	,, 24	496	+ 106	,,	4,176	+ 323	2·9	..
‡Metropolitan	,, 24	8,001	+3,t?0	,,	84,300	+20,667	22	..
Middleton	,, 24	800	+ 133	,,	6,687	+ 251	8·5	..
Mid. Joint Com'tee	,, 24	13,446	+1,714	,,	113,760	+ 3,056	..	..
Oldham — Ashton	,, 24	1,296	+ 129	,,	11,922	+ 837	9·13	..
Peterborough	,, 24	257	+ 65	,,	2,?50	+ 89	5·31	..
Potteries	,, 24	4 086	+ 513	,,	37,442	+ 974	29	..
Rothesay	,, 24	343	+ 34	,,	1,906	+ 27	2·75	..
Southport	,, 24	767	+ 248	,,	5,112	— 2	8·17	..
S. Metropolitan	,, 24	1,751	..	,,	14,524	..	..	..
Swansea	,, 24	1,957	+ 362	,,	16,603	+ 769	5·5	..
Tynemouth	,, 24	544	+ 144	,,	3,611	— 44	3·75	..
Weston-s-Mare	,, 22	387	+ 255	,,	1,223	+ 171	3	..
‡Worcester	,, 24	654	+ 138	,,	5,169	+ 52	5·75	..
Wrexham	,, 24	221	+ 37	,,	1,976	+ 13	..	..
Yorks. Wool. Dist.	,, 24	2,166	+ 432	,,	19,016	+ 1,559	17	..
Miscellaneous	,, 24	515	+ 21	,,	4,201	— 47	..	..
Burnley	June 1	2,585	+ 265	..	..	..	7·5	..
Burton-on-Trent	,, 2	607	+ 20	9	2,585	— 128	10	1·5
†Bury	May 19	999	..	7	6,790	..	10·5	..
Cardiff	June 1	4,627	+ 745	9	18,537	+ 872	15·87	..
Carlisle	,, 1	373	— 14	22	3,432	— 242	..	..
Chatham and Dist.	May 30	1,542	+ 292	22	14,381	+ 1,272	12·84	3·51
Cork	,, 30	1,015	— 46	22	9,297	— 140	9·89	..
Croydon	,, 31	3,063	+ 224	9	12,540	— 342	12	·75
Darlington	June 1	434	+ 17	9	1,839	+ 30	..	..
Darwen	May 31	563	+ 74	9	2,264	+ 1	4·36	..
Dover	June 1	487	+ 25	9	1,965	— 98	4·75	..
Dublin	May 31	12,694	+3,683	22	108,765	+ 7,328	51·25	5·5
Dundee	,, 29	2,233	+ 154	2	2,233	+ 154	12	·5
East Ham	June 1	1,956	+ 238	9	8,175	+ 85	8	..
Exeter	May 31	716	+ 200	9	2,794	+ 894	4·75	·5
Glasgow	June 1	33,318	+1,343	44	890,993	+70,641	84·25	4·75
Hastings	May 31	2.869	..	..	..	..	..	..
Huddersfield	June 1	3,319	+ 412	9	14,225	+ 1,091	28	..
Hull	,, 1	4,916	+ 588	9	21,140	+ 1,441	13	..
†Ilford	May 11	560	+ 37	6	2,884	— 117	6·37	..
Ilkeston	,, 29	307	+ 76	9	1,275	+ 197	3·5	..
Ipswich	June 1	849	+ 71	9	3,441	— 34	10·5	..
Isle of Thanet	,, 1	1,283	+ 376	22	7,377	+ 475	11	..
Kilmarnock	,, 1	316	+ 5	2	423	+ 24	4·25	..
Lan'kshire Trm. Co.	May 30	2 444	+ 71?	22	23,546	+ 5,056	15·82	3·26
Lancashire United	,, 29	3,313	+1,586	22	25,725	+ 7,729	38·5	10·5
†Leeds	,, 25	7,242	+1,340	8	51.796	+ 4,599	96	6·5
Leicester	June 1	4,724	+ 4?7	..	..	..	..	..
Leith	,, 1	1,013	+ 9	2½	1,315	— 44	6	..
Liverpool	May 25	22,459	+1,365	21	220,548	+ 4,545	104	..
‡L.C.C.	,, 25	55,489	+14,75?	8	242,337	+36,186	115·5	18·5
London United	,, 31	15,883	+3,476	22	126,399	+ 7,?98	..	..
Lowestoft	June 1	382	+ 99	35	5,424	+ 784	3·5	..
Manchester	,, 1	32,418	+6,101	9	180,049	+15,547	172	21
Newcastle	,, 1	8,112	+ 113	7	36,288	+ 1,045	..	..
Newport	,, 1	1,506	+ 310	9	5,997	+ 563	14·5	..
Northampton	May 31	974	+ 161	8½	3,826	+ 139	5·5	..
Oldham	June 2	3 873	+ 266	10	19,342	+ 1,866	23·75	..
Pontypridd	,, 1	618	+ 304	9	2,475	+ 942	5	1·75
Portsmouth	,, 1	4,177	+ 791	9	16,937	+ 670	14·5	..
Preston	May 29	1,720	+ 363	..	..	..	..	..
†Reading	,, 30	593	— 9	8⅔	5,985	+ 114	13·25	..
Rochdale	Feb. 19	958	+ 152	..	..	..	20·6	..
Rotherham	May 30	1,512	+ 412	9	5,103	+ 976	10	·66
Salford	June 3	10,565	+1,481	9	42,795	+ 2,422	38·9	..
Sheffield	,, 2	11,309	+ 513	10	54,594	+ 3,162	35·75	..
Southampton	May 29	3,071	+ 260	84	8,130	+ 401	..	..
Southend-on-Sea	,, 29	834	+ 190	9	2,923	+ 75	..	..
Sunderland	June 2	2,849	+ 102	9	12,248	+ 277	..	..
Swindon	May 29	344	— 19	..	..	..	4·4	..
Tyneside	,, 29	894	+ 171	22	8,978	+ 845	8·87	..
Wallasey	June 1	1,822	+ 320	9	7,266	+ 506	8·55	·05
Walthamstow	,, 1	1,392	+ 247	9	5,263	+ 229	9	..
West Ham	May 30	4,871	+ 624	9	21,520	+ 1,553	14·7	..
Wolverhampton	,, 29	2,154	+ 603	8	7,564	+ 759	20	..
Yorks. W. Riding	June 2	2,609	+ 904	22	24,279	..	..	..
Baker St.-Waterloo	,, 1	4,926	+2,181	12	23,820	+10,227	4	·75
Cen. London Rly.	,, 1	11,253	—1,458	22	134,545	—14,178	6	..
City & S. Lon. Rly.	,, 2	3,057	+ 894	22	65,124	+ 2,410	7·3	1·05
Dublin-Lucan Rly.	May 31	286	+ 80	22	2,289	+ 68	7	..
G.N. and City Rly.	June 1	3,410	+ 41	22	40,066	+ 92	3·5	..
G.N., P'dy. & Brmp.	,, 1	8,500	— 126	22	85,219	..	9	..
L'pool Overh'd Rly.	,, 2	3,234	+ 391	22	31,466	+ 733	6·8	4·3
Mersey Railway	,, 1	3,732	+ 380	22	40,326	+ 2,096	4·5	..
Metropolitan Rly.	,, 2	31,412	— 51	22	333,123	—25,608	24·5	..
Met. District Rly.	,, 2	16,286	— 689	22	172,791	— 8,887	24	..
Anglo-Argentine	,, 3	33,214	+4,363	22	363,905	+33,270	48	..
§Auckland	May 24	10,246	+ 457	20	58,380	+ 3	19·2	·66
§Brisbane	,,	13,275	+1,584	..	..	..	..	..
§Brit. Columbia Rly.	Apr.	24,067	+5,623	37	245,426	+48,466	..	..
Bu'n's A'r's E.T.Co.	Mar. 2	3,247	+ 290	9	14,647	+ 1,859	..	..
†Bu'n's A'r's-Blgr'no	Apr. 21	3,911	+ 314	16	60,228	+ 4,091	..	..
Calcutta	June 1	5,923	+ 278	..	..	..	..	..
§Geneva	Apr.	7,256	+ 306	..	..	..	..	..
§Kalgoorlie, W.A.	,,	3,895	..	17	15,608	..	20·5	..
Madras	May 31	1,140	+ 248	21	11,504	+ 1,921	12·75	3·5
§Lisbon	Apr.	25.661	..	..	..	..	..	..
Perth (W.A.)	May 31	2,639	— 243	22	32,329	— 840	25·6	·4

* Compared with the corresponding period of 1906. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

That presentiment of ill hanging over the markets of the Stock Exchange, to which reference was made here last week, is deepened rather than otherwise now. The failures that arose out of the end of May Stock Exchange settlement have been followed by the exposure of financial trouble in provincial centres, while rumour adds vague talk of certain Paris operators being in difficulties. Consols have fallen to the basis at which they yield practically 3 per cent., and the Home Railway market has suffered severe losses.

Yet Central London Deferred is 3 points better at 54½. This is about the only exhibition of strength in the Home Railway departments, and it is supplemented by rises of a point in Central London Ordinary. City and South London advanced to 42, but fell off a point. The company published a traffic increase for the half-year to date of £2,410, and the Euston extension is said to be doing good business.

The Charing Cross, Euston and Hampstead board have aroused public attention by the novel scheme of giving passengers free travel on the day the line is opened, but the 4 per cent. Debenture stock remains at 84½. Bakerloo Debenture changed hands at 90½ on Monday. Piccadilly Debenture is 86½, somewhat nominally. Underground Electric 5 per cent. Profit-sharing notes are 4 down, at 71½, of which 2½ is represented by the interest just deducted.

District stock dropped 4 points, with hardly a thousand pounds of it changing hands. The price was marked down to 10, from which there has been a two points recovery; and Metropolitan Consolidated is down to 39, a couple of points less than City and South London Ordinary stock. One proprietor of Metropolitan stock was overheard this morning to advocate the re-transforming of the system back to the steam, dirt, sulphur and better traffics that were superseded by the electrification.

Apart from the Home Railway department, the most interesting market news is the sudden rise in British Electric Traction issues. The Ordinary shares jumped up 17s. 6d., the Preference £1, and the First Debenture stock 3 per cent. What has caused this sharp turning movement nobody seems to know. Students who, for their sins, are doomed to watch the papers, have noticed the little items of optimistic import concerning the company that have appeared lately. It would seem as though the paragraphs had not been ineffectual; at least, that is the surface impression conveyed. But some men are doubters, as some deceivers, ever, and suggest that shareholders should seize the opportunity now presented to them of getting out of their holdings on the rise. And that there has been a little selling is seen in the reaction on Tuesday afternoon in the Ordinary and Preference shares.

Anglo-Argentine Trams and Buenos Ayres and Belgrano Trams are harder upon the conclusion of the strike on the Argentine railways, which, it was feared, might have caused labour troubles to spread to the tramways too. Then there is the vague rumour that a Belgian group wants to obtain entire control of the Anglo-Argentine system. The result has made the Ordinary shares ⅜ better at 8⅞. The new scrip, 40 per cent. paid, of the British Columbia Electric Railway, is quoted at a small discount. London United Tramways Debenture gave way 1 per cent. to 88. A number of the inhabitants of Barnes are agitating for the removal of the motor 'buses from their peaceful streets, and the time is, perhaps, ripe for negotiations to be re-opened if the London United Tramways still cherish their original idea of traversing the riverside suburb.

Not a price has varied in the list of electricity supply shares since this time last week. Two or three Debenture stocks are lower; that is the only change. Edmundsons 4½ per cent. Debenture was let down seven points, and business has been marked at 80. At this, the yield on the money comes to little short of 6 per cent. The service, for interest, takes about £10,250 each half-year, and the security, one would imagine, ought to be sufficient to justify purchases of the Debenture stock at the present price. But the directors owe it to their fellow-shareholders to issue a clear statement of the Corporation's position at the present time, and it is surprising that this was not done immediately after the notices went out last month respecting the passing of the Preference divdend.

Telegraph and Telephone issues are quietly steady, and there has not been much variation except for a few ex. divd. markings. Globe Telegraph Ordinary are ⅛ higher, and National Telephone Deferred improved to a small extent. Anglo-American Telegraph "A" has been fluctuating in sympathy with Americans.

British Aluminium 7 per cent. Preference are rather lower at 5⅞, and Dick, Kerr Preference fell 1/16. Callender's at 10½ were ¼ weaker. Brush Preference are down to a sovereign.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations May 28th.	Closing Quotations June 4th.	Business done week ended June 4th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	.	3 — 3½	3 — 3½	..	..	..	Nil
149 600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	88 — 91	88 — 91	88⅓	88	..	5 9 11
660,660	Anglo-American Telegraph	Stock	61s.	2½%	3½%	3⅝%	61½ — 64½	61½ — 64½	..	..	..	6 0 2
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	107 —108	107 —108	108⅛	107½	..	5 11 9
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	⅛%	1¾%	19¼ — 19¾	19¼ — 19¾	20 1/16	19	..	8 17 3
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	..	99 —101	99 —101	..	..	..	4 19 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	..	6¾ — 7¼	6¾ — 7¼	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	92⅜ — 94½	92⅜ — 94½	93	92¼	..	4 4 8
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	6 1 3
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15½ — 16½	15½ — 16½	..	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..	5 8 6
8,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¾ — 9¼	8¾ — 9¼	..	..	..	5 8 1
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
60,710	Direct United States Cable	20	5 %	5½%	4½%	..	15⅛ — 16	15⅛ — 16	15⅞	15 11/16	..	5 6 3
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	136 —141	137 —142	141	139½	+1	4 18 7
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	89 — 91	89 — 91	90½	89½	..	3 16 11
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	104¼ —106½	104¼ —106½	105⅝	..	..	3 15 2
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13⅝ — 14¼	13⅝ — 14	14	13⅝	— ¼	5 0 0
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	104½ —106¼	104⅛ —106¼	104	..	..	3 15 2
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
191,127	Globe Telegraph and Trust	10	5½%	5⅝%	5⅝%	5⅛%	10⅝ — 11⅛	10⅞ — 11⅛	11⅛	10 15/16	+ ⅛	4 17 9
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅝ — 14⅜	13⅞ — 14⅜	14⅛	13⅝	..	4 3 6
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	24 %	24%	20 %	84 — 86	84 — 86	35½	34½	..	5 11 1
88,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100—102	100 —102	..	..	..	4 8 3
17,0 0	Indo-European Telegraph	25	10 %	18 %	13 %	13 %	56 - 58	56 — 58	..	..	..	5 12 1
$41,580,400	Mackay Companies Common	$100	..	..	..	..	71 — 3	71 — 3	..	..	..	..
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	..	..	..	69 — 71	69 — 71	..	..	..	..
456,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	3/16 — ¼	3/16 — ¼	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	4 %	5 %	..	1 — 1 1/16	1⅛ — 1 1/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞ — 1	⅞ — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	108 —110	109½	108	..	5 9 1
2,225 000	Do. do. Def. Stock	100	5 %	5 %	5 %	5⅝%	104⅛ —106⅜	105 —107	106¼	104⅜	+ ⅛	5 2 10
1£,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11⅛ — 12⅛	11⅛ — 12⅛	12	11⅜	..	4 8 11
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	..	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 5/16 — 5 7/16	5 5/16 — 5 7/16	5 7/32	5 3/32	..	4 9 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3⅜%	95½ — 97½	96½ — 97½	..	..	..	3 11 10
1,989,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6½%	6½%	7½%	7 %	1 7/16 — 1 7/8	1 5/16 — 1 7/8	..	..	..	5 4 4
50,000	Do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1½ — 1¾	1½ — 1¾	..	..	..	4 16 0
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
11,889	Reuter's	8	5 %	5 %	5 %	..	7½ — 8½	7½ — 8½	..	..	..	4 14 1
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
8,167	Submarine Cables Trust	Cer	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
80,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛	6 13/16	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5 — 5⅛	5 — 5⅛	5 1/16	5⅛	..	4 10 11
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	108½ —111½	109	..	— ½	4 9 8
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10⅛	10 — 10⅛	..	..	..	3 16 2
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2	Nil	Nil	Nil	2½%	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	13⅞ — 14⅜	13⅞ — 14⅜	14⅛	14	..	4 19 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..	3 16 2
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	3/16 — ¼	3/16 — ¼	..	..	..	Nil
34,668	Do. do. 6 % Cum. 1st Pref.	10	7 %*	6 %	5 %	8 %	7⅞ — 8⅜	7⅞ — 7⅞	..	..	— ⅜	10 0 6
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6⅜ — 7⅜	6⅜ — 7⅜	7⅛	..	..	Nil
20,000	Do. 5 % Debs., Nos. 1 to 1,500	100	5 %	5 %	5 %	5 %	100 — 103	100 —103	..	..	..	4 17 1

Including arrears

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

0,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	..	..	8 %	8 %	8 %	7⅞ — 7⅞	7⅞ — 8⅛	8 1/16	7 15/16	+ ⅛	4 15 6
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	5 11/16 — 5 13/16	5⅝ — 6	5⅞	5 11/16	+ 1/16	4 11 8
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	133 —136	133 —136	135½	135	..	4 8 3
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 —107	104 —107	..	..	..	4 13 6
880,000	Babcock & Wilcox, 1 to 880,000	1	17 %	20 %	20 %	20 %	3½ — 4	3⅝ — 4	78/1	75/7½	..	5 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 7/16 — 1 9/16 xd	1 7/16 — 1 9/16	..	..	..	3 15 7
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	..	5¼ — 5⅜	5¼ — 5⅜	5⅛	..	..	6 1 9
40,000	Do. do. 7 % Cum. Pref...	5	Nil	7 %	7 %	..	5⅜ — 6⅛	5⅜ — 6⅛	6	..	— ⅛	5 14 3
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	..	5¼ — 5⅜	5⅛ — 5⅜	..	..	..	5 4 4
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	..	4 — 4⅛	4 — 4⅛	..	..	..	4 8 11
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	99 —103	100 —103	101	..	+ ½	4 17 1
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	98 —101	98 —101	100	..	..	5 8 11
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	123 —127 xd	123 —127	..	..	..	4 14 6
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	106 —111	103½ —108½ xd	..	..	..	4 12 2
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	102 —106	102 —106	104¼	103	..	4 14 4
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	99 —102	99 —102	101¼	..	..	4 8 3
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102¼—104½	102½—104½	..	..	..	4 6 2
188,301	British Electric Traction	10	6 %	6 %	8 %	..	2⅜ — 2⅝	3⅛ — 3⅜	76/3	68 9	+ ⅜	8 0 0
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	6¾ — 7	7⅛ — 7⅜	7⅜	7 1/16	+ 1/16	7 14 10
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	98 —102	101 —105	102½	98½	+3	4 17 1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	..	79 — 82 xd	79 — 82 xd	..	..	..	5 9 1
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6¾ — 7	6¾ — 7	..	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
219,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	..	92 — 96	92 — 96	..	..	..	4 13 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..	..	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	64 — 68	64 — 68	..	..	..	5 17 8
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	7/16 — ½	7/16 — ½	..	..	..	Nil
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	2½%	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	1 — 1⅛	⅞ — 1⅛	..	..	— ¼	Nil
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	89 — 92	89 — 92	..	..	..	4 17 10
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	75 — 78	75 — 78	..	..	..	5 15 5
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	3⅛ — 3⅜	3⅛ — 4	77/6	67/3	+ ⅛	3 15 0
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅛ — 4⅜	4⅛ — 5⅛ xd	5	97/6	..	5 17 1
27,500	Do "B" do. 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅛ — 5⅛	4⅛ — 5⅛ xd	..	..	..	5 14 3
18,200	Do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	110	..	..	4 6 11
190,000	Do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
137,610	Calcutta Trams., 1 to 137,610	5	8 %	8 %	8 %	8 %	7⅞ — 8	7⅞ — 8 xd	7⅞	7 15/16	..	5 0 0
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330	5	..	..	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 6 11
860,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..	4 3 4
85,000	Callender's Cable Construction shares	5	12½%	12½%	15%	15 %	10½ — 11⅛	10 — 11	..	..	— ⅛	6 16 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106⅛—108⅛	106⅛—108⅛	..	..	..	4 2 11
491,222	Cape E. Trams., 1 to 491,222	1	10 %	5 %	Nil	..	3/16 — ¼	3/16 — ¼	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16 xd	24/6	..	..	6 1 11
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	..	..	..	4 8 8
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	69 — 71	70 — 72	70	..	+1	5 11 1
544,216	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	..	..	..	4 5 1
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	53 — 53	73 — 76	..	..	+3	7 2 10
1,480,000	City and South London Railway	Stock	2¾%	2¾%	1¾%	2¾%	40 — 42	40 — 42	42	10⅜	..	5 1 2
85,000	Crompton & Co., Nos. 1 to 85,000	5	2½%	2½%	2½%	..	1 3/8 — 2 1/16	1 3/16 — 2 1/16	..	..	..	3 14 0
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..	5 1 0

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated, all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(Continued.)*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations May 28th.	Closing Quotations June 4th.	Business done week ended June 4th, 1907.		Rise + or Fall —	Present Yield per cent
		†	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1 5/16 — 1 9/16	1 5/32 — 1 9/32	..	..	..	7 16 10
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 1/8 — 1 1/4	1 1/16 — 1 1/4	..	..	— 1/32	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6¼%	6 %	6 %	..	13½ — 14½	13½ — 14½	..	..	..	4 2 9
59,987	Do. 6% Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	13 — 14	13 — 14	..	..	..	4 9 3
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,361	5	Nil	2½%	4½%	..	1 — 1⅛	1 — 1⅛	22/6	20/3	..	10 0 0
17,189	Do. "A" shares, 01—017,189	5	Nil	2½%	4½%	..	2¼ — 2⅜	2¼ — 2⅜	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 92	89 — 92	..	..	..	5 8 8
112,100	Electric Construction 1 to 112,100	2	4 %	Nil	Nil	..	½ — 7/16	½ — 7/16	..	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	1⅝ — 2	1⅝ — 2	..	..	..	7 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8⅝ — 9⅜	8⅝ — 9⅜	..	..	..	5 2 4
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	92 — 95 xd	92 — 95	..	..	..	4 4 3
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	8 %	4 %	4 %	4 %	2¼ — 2⅜	2¼ — 2⅜	..	..	..	14 10 10
96,000.	Greenwood & Batley 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10⅜ — 10⅝	10⅜ — 10⅝	..	..	..	6 13 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	103 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11⅜ — 12⅜	11⅜ — 12⅜	..	..	..	5 17 8
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	3 15 7
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	105 —107 xd	..	..	..	4 4 1
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10%	5 %	10%	10 %	15 — 16	15 — 16	15 9/16	15 3/16	..	6 5 0
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜%	1½%	Nil	Nil	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6⅜ — 7⅛	6 — 7	..	..	— ½	7 2 10
600,070	London United Trams (1901), 1 to 50,007	10	8 %	6 %	8 %	3 %	8¼ — 8⅜	8¼ — 8⅜	..	..	..	8 8 7
899,930	Do. do. 50,008 to 100,000	10	8 %	6 %	8 %	3 %	7 — 7⅛	7 — 7⅛	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	6 %	5 %	5 %	5 %	7⅜ — 8⅜	7⅜ — 8⅜	..	..	..	5 14 3
1,881,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	85 — 89	84 — 88	..	..	—1	4 10 11
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
600,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/32 — 1/8	3/32 — 1/8	12/6	..	..	5 3 11
850,000	Do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
30,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	4 — 4½	4 — 4½ xd	..	..	..	7 10 0
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	3/8 — 7/16 xd	3/8 — 7/16	..	..	..	6 8 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/2 — 9/16	1/2 — 9/16	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	96½ — 99¼	96½ — 99½ xd	..	..	..	4 10 6
87,850	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	30½ — 32½	31½ — 32½	..	..	..	5 11 1
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100½ —103½	101 —104	..	..	+ ½	3 16 11
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	74 — 77	70 — 73 xd	..	..	—3	6 17 5
66,666	Willans & Robinson, 1 to 30,000 & 30,001 to 116,666	5	3 %	Nil	Nil	..	1½ — 1⅝	1½ — 1⅝	..	..	..	Nil
66,666	Do. 6 % C. P., 30,001 to 30,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3⅜ — 4½	3⅜ — 4½	75/-	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	79 — 83	78 — 82	..	..	—1	4 17 7

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5⅛%	5⅛%	5⅛%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 4 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	97 — 99 xd	97 — 99	..	..	..	4 10 11
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	8 — 9	8 — 9	..	..	..	5 11 1
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7½ — 8½	7½ — 8½	..	..	..	4 2 4
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	98 —101 xd	..	..	..	3 19 3
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3½ — 4⅛	3½ — 4⅛	70/-	..	..	5 11 1
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..	5 5 11
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..	4 14 9
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9⅞ — 10½	9⅞ — 10½	9⅞	..	..	5 14 3
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅞ — 12⅛	11⅞ — 12⅛	11⅞	..	..	4 18 0
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	123	..	..	3 19 4
200,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	97 —100	97 —100	99	..	..	4 10 0
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4½ — 5	4½ — 5	..	..	..	4 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	7½ — 8½	7⅞ — 8½	..	..	..	5 17 8
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 11½	10½ — 11½	..	..	..	5 4 4
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	95 — 98 xd	94 — 97	95	94	— 1	4 12 9
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	..	⅞ — 1⅛	⅞ — 1⅛	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	1½ — 2⅛	1½ — 2⅛	40/-	36/3	..	12 0 0
350,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	85 — 90	78 — 83	80	..	— 7	5 0 0
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅞ — 5⅜	4⅞ — 6⅛ xd	..	..	..	5 8 5
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5½	5 — 5½	..	..	..	4 15 3
90,000	Do. 4½ % 1st. Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
18,000	Hove, 1 to 18,000	5	8½%	8½%	9 %	9 %	7 — 7⅛	7 — 7⅛ xd	..	..	..	6 0 0
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	12 %	10 %	10 %	8½ — 9⅛	8½ — 9⅛	..	..	..	5 0 0
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	5 6 8
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 14 3
674,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	95 — 98	95 — 98	97	..	..	4 11 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅜%	10 %	10 %	8 %	5⅜ — 6⅜	5⅜ — 6⅜	6	5 13/16	..	6 8 0
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 8 9
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 —109	105 —109	..	..	..	4 2 7
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	88 — 93	88 — 93	..	..	..	3 15 3
950,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..	5 3 3
75,000	Do. 5 % Pref., 1 to 75,000	5	5%	5 %	5 %	5 %	5 — 6	5 — 6	..	..	..	4 3 4
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	12 — 13	12 — 13	..	..	..	5 15 5
64,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6⅜%	7 %	7 %	7 %	6 — 6½	6 — 6½	..	..	..	5 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..	4 1 5
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅜%	14⅜%	12½%	10 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	5 17 8
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	6½ — 7⅛	6½ — 7⅛	..	..	..	4 13 4
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	88 — 93	88 — 93	..	..	..	3 15 3
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	1½ — 2⅛	1½ — 1⅝	..	..	..	Nil
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..	5 3 11
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2⅛ — 2⅜	2⅛ — 2⅜	..	..	..	5 9 1
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2⅛%	2⅛%	⅝ — ¾	⅝ — ¾	22/6	..	..	3 6 8
117,988	Do. Do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 1 10
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1½ — 2⅛	1½ — 2⅛	..	..	..	10 0 0
60,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2⅜ — 3⅛	2⅜ — 3⅛	60/-	..	..	7 2 10
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
110,000	Westminster Electric Supply, Ord.	5	13⅛%	14 %	13 %	12 %	9 — 10	9 — 10	9/8	..	..	6 0 0
81,279	Do do. 4½ % Cum. Pref. (Original 5%— Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	4½%	5½ — 5⅝	5½ — 5⅝	..	..	..	3 18 3

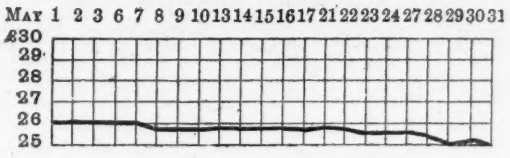
Unless otherwise stated all shares are fully paid. § Interim dividends

Bank rate of discount 4 per ent. April 25th, 1907.

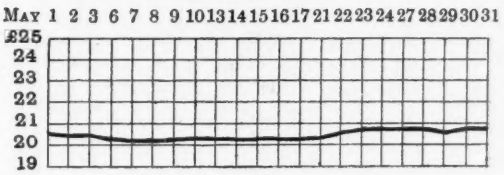
METAL MARKET.

Fluctuations in May, 1907.

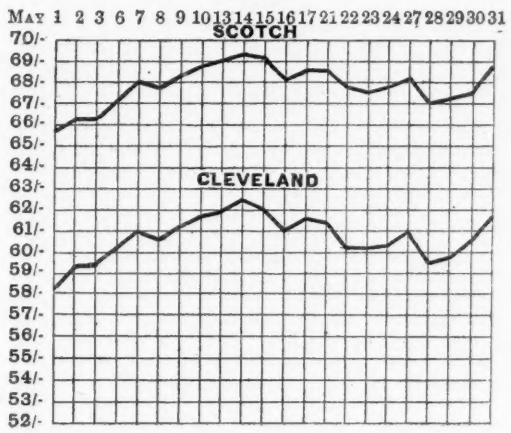
SPELTER (G.O.B's.)



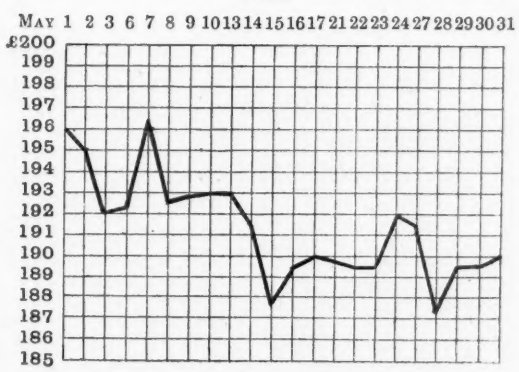
LEAD (ENGLISH)



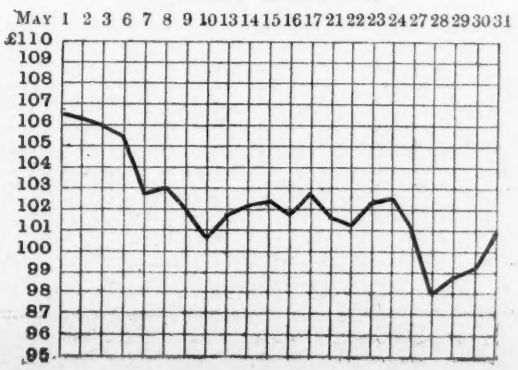
IRON.



TIN.



COPPER (G.M.B's.)



ECONOMICAL TESTING OF GENERATORS AND MOTORS.

By J. LEWIS COOK.

It is the intention of this article briefly to consider methods of testing D.C. machines in which the power developed by the machine under test is partly used to drive it.

The Hopkinson methods are the most important, and are well known for shunt machines, but there often seems to be some doubt as regards series and compound machines. These methods involve an external source of energy to supply that lost in the load and driving machine; only those in which this energy is supplied electrically will here be considered. The chief disadvantage of the Hopkinson methods is that they necessitate having two similar machines, but if these are available, the efficiencies can be determined with but small error, and the machines run on full load with but little waste of power.

The methods may be divided into two main classes:—

1. Those in which the machines under test are in series with the "make-up";

2. Those in which the machines under test are in parallel with the "make-up."

Speaking generally, the series methods would be used when the current capacity of the "make-up" is not less than that of one of the test machines, and the parallel methods when the voltage capacity of the "make-up" is not less than that of one of the test machines.

1. *Series Tests for two Similar Machines.*—The connections are the same both for shunt and compound wound machines, and are as shown in fig. 1.

The series arrangement is more suitable for testing motors than generators, as the machine acting as motor in the test is under running conditions, while the generator will have a higher voltage across its field than its armature is developing.

With two compound-wound motors, the series field of the machine acting as generator should be reversed, or with two generators, the series field of the one acting as motor should be reversed. Otherwise one machine will be cumulatively

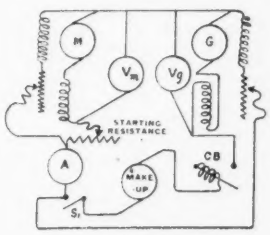


Fig. 1.

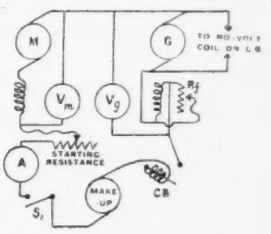


Fig. 2.

wound, and the other differentially, so that steady running will not be obtained. This applies if the machines are mechanically coupled to run in the same direction looking at the commutator ends, but if they are to run in opposite directions, then it is the shunt field which must be reversed instead of the series. Uncoupled from the motor, the machine acting as generator should run in the reverse direction, with switch S_1 and circuit-breaker C B (fig. 1) closed.

The set should be started up with the motor field strong, and the generator field weak; the load may be increased by increasing the generator field, or if the speed is low, by increasing the "make-up" voltage or weakening the motor field.

The connections for two series machines are practically the same as for two compound-wound machines; instead of the shunt-field resistances, a resistance R_f must be put in parallel with the series winding of the generator, in order to make its field weaker than that of the motor (see fig. 2). The magnitude of this resistance will be of the order of 10 times that of the series winding; start up with the generator field weak, that is, with R_f small; before cutting out all the starting resistance, increase R_f until full load current is flowing, then cut out the starting resistance and adjust the "make-up" voltage to give the correct voltage on the motor M.

To test the connections, the circuit may be momentarily closed with the machines uncoupled ; the generator should then run in the opposite direction to that in which the motor will drive it. The circuit must not be left closed, as being series machines, with no load on, they would race away. To guard against racing, should the belt accidentally come off, it is well to have a circuit-breaker in use with a special "no-volt release" ; the coil actuating this release will be put across the machine acting as generator ; should the belt for any reason come off, the voltage across the generator will reverse, hence there will be a moment of no voltage during which the release will work, opening the main circuit. This release may be held in during starting up.

Efficiency Formula for Hopkinson Series Tests.

Motor input $= A V_m$.

Generator output $= A V_g$ (see figs. 1 and 2).

There must be some loss in the mechanical coupling, of whatever type it be ; divide this loss between the two machines and let—

L_g = generator loss and L_m = motor loss.

Then generator input = motor output

$= A V_g + L_g$ (figs. 1 and 2).

Total loss $= A (V_m - V_g) = L_g + L_m$.

The load on the two machines will differ but little, so it will be nearly correct to assume the efficiency of each to be the same, that is the loss in each to be proportional to its input. Thus—

$$\frac{L_g}{L_m} = \frac{A V_g + L_g}{A V_m},$$

then $$L_g = L_m \frac{(A V_g + L_g)}{A V_m},$$

and $$\frac{L_g A V_m - L_m L_g}{A V_m} = \frac{L_m A V_g}{A V_m},$$

so that $$L_g = \frac{L_m A V_g}{A V_m - L_m}. \quad \ldots \quad \ldots \quad (1)$$

But $$L_m + L_g = A (V_m - V_g),$$

$$L_g = A (V_m - V_g) - L_m,$$

hence from (1) $$A (V_m - V_g) - L_m = \frac{L_m A V_g}{A V_m - L_m},$$

$$A^2 V_m^2 - A^2 V_m V_g - A V_m L_m + A V_g L_m - A V_m L_m + L_m^2 = A V_g L_m,$$

$$L_m^2 - 2 A V_m L_m = A^2 (V_m V_g - V_m^2),$$

$$L_m^2 - 2 A V_m L_m + A^2 V_m^2 = A^2 V_m^2 + A^2 V_m V_g - A^2 V_m^2,$$

$$L_m - A V_m = \pm \sqrt{A^2 V_m V_g},$$

$$L_m = A V_m \pm A \sqrt{V_m V_g};$$

or, in practical cases, $L_m = A V_m - A \sqrt{V_m V_g}$,

hence motor output $= A V_m - (A V_m - A \sqrt{V_m V_g})$,

$$= A \sqrt{V_m V_g},$$

and motor efficiency $= \frac{\text{output}}{\text{input}}$,

$$= \frac{A \sqrt{V_m V_g}}{A V_m},$$

$$= \sqrt{\frac{V_g}{V_m}}.$$

It was assumed that the efficiency of each machine was the same ; hence efficiency of each machine

$$= \sqrt{\frac{V_g}{V_m}}.$$

The chief source of error in obtaining the efficiency by this method is the loss in the mechanical coupling ; this, however, will be small with a good belt, or with the machines directly coupled in good alignment. Another source of error is in assuming that the two efficiencies are the same, whereas the loads differ ; this error is inappreciable with machines of good efficiency, but becomes greater as the efficiency decreases.

Parallel Tests for Two Similar Machines.—The connections are, as in the series tests, practically the same both for shunt and compound-wound machines (see fig. 3) ; also the same holds true as regards reversing the field of one machine if they are compound-wound, as in the series arrangement.

The parallel test is more suitable for generators than motors, as the machine acting as generator has its full field, and can be tested for voltage, sparking, &c. ; to get full armature current in the generator, the motor would have to be a little overloaded. Start up with the switch S_1 open (fig. 3) ; close S_1, when V_g is a little greater than V_m. Do not open S_1 with much load on, if the machines are compound-wound, as it would mean a sudden weakening of the motor field, which might bring the main breaker C B out, the latter being set for less than the full-load current of M. The load is increased by weakening the motor field, strengthening the generator field, or increasing the make-up voltage.

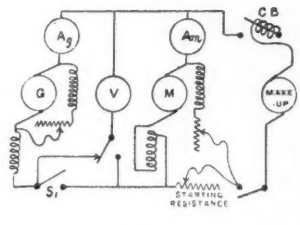


FIG. 3.

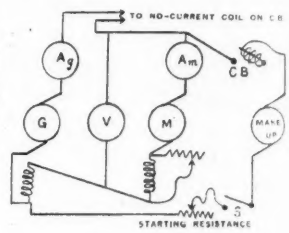


FIG. 4.

Uncoupled, the machines should tend to run in the same direction.

The connections for series machines are shown in fig. 4. The two fields must be connected in series, with the armatures in parallel in such a way that each machine, if uncoupled and driven from the "make-up," would rotate in the same direction. Care must be taken in starting up to have the motor field sufficiently well shunted, as otherwise the load will be small and the machines will race. To prevent racing, should the belt break or come off, a "no-current" release circuit breaker C B may be used, to operate in one of the make-up leads ; this breaker will be worked by a coil in the generator circuit, besides the ordinary overload release ; should the belt come off, the current through G will reverse, so that at one moment there will be no current flowing through G, and hence none through the "no-current" coil of the breaker, so that the breaker will then cut off the machines from the supply.

The formula for the efficiency in parallel tests works out in just the same way as that in series tests.

Motor input $= V A_m$ (figs. 3 and 4),

Generator output $= V A_g$,

Generator input = motor output $= (V A_g + L_g)$,

Total loss $= V (A_m - A_g)$,

and so on, substituting V for A and A for V in the equations for the series tests.

The result is, efficiency of each machine

$$= \sqrt{\frac{A_g}{A_m}}.$$

Running Two Dissimilar Machines Together.—As a rule this cannot be done in just the same way as with two similar machines, as the load would not keep steady. In fact, in running two similar machines, it is often necessary to see that they have a similar amount of brush lead, the lead being positive for the generator and negative for the motor.

One method, which can often be employed in cases corresponding to parallel Hopkinson tests, is to insert a series resistance between the two machines. A typical case, and one in which such a resistance is particularly needed, is running a compound-wound generator with a shunt-wound motor. With a compound-wound generator, the load would increase the

E.M.F., and the E.M.F. in its turn would increase the load; this cumulative effect is destroyed by the series resistance, if the resistance be of such a value that the increased drop across it for any increase in current is not less than the increase in E.M.F. due to the compounding. The connections

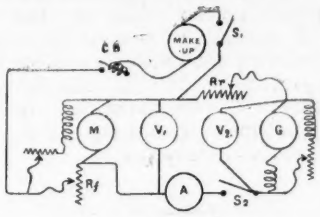


FIG. 5.

are shown in fig. 5, in which R_f is the series resistance, and R_f the starting resistance. V_2 should not be less than V_1 when closing switch S_2. In this case, of course, the efficiency could not be so well determined as with two similar machines, but a great saving in power used is effected, by utilising the generator power.

COMPETITION: A SUGGESTION.

[COMMUNICATED.]

IT has been the lot of engineers, particularly on the electrical side, to experience many wide and daring changes within the past 20, or even 10 years, all the world over; but to give even a summary of such changes is quite beside the range of this article. Sufficient it is to say, that a huge industry, collectively, has sprung up in several centres of the ruling countries of the world to meet the ever-increasing demands made upon the evolutions of electrical science.

The result is that a vast and promiscuous body of the younger generation swells its numbers year by year—some well fitted for their calling by keen application in full-time training, but the majority with but a smattering of rudiments in general and with but a vague idea as to the direction in which their *forte* really lies.

The general summary of such conditions is that competition of the keenest description (*inter alia*, for service pay) is rife in every branch of the industry, and this is only too plainly emphasised by the yearly reports of several manufacturing and trading concerns.

But while the supply of graduated assistants far exceeds the demand, it is generally conceded that there is always a vacancy for "young intelligence" in one branch or another, and the wise employer is he who can detect character and merit in, perhaps, a single sentence or action of the individual under observation.

But why is it, in this country, at any rate, that trading profits have been dwindling, or even worse than that, for the past year, at least, while the near future teems with rumours of amalgamation of rival industries and uneasy forebodings as to the ultimate composition of staffs in general?

I would hazard one guess as to a part cause of the trouble, viz., lack of organisation, or, more boldly, mismanagement! And one does not make this indictment without having made protracted observations of the methods of various firms in fulfilling their obligations to their clients.

How often is an error, quite likely a serious one, condoned by the usual letter of regret and the promise that it shall not occur again, with ample assurances that the damage will be made good, &c.; or again, the delay in the delivery of plant which has been ordered, is attributed to excessive pressure of work in that department—in point of fact, the estimating engineer has made a shot at the time of delivery and missed by many weeks.

The conditions of demand and supply in several industries, vary so erratically, that it is perhaps difficult to gauge exactly the proper strength of official and working staffs with respect to the volume of work accepted, and the space within which to do that work, but it seems that orders are too freely booked without the remotest chance of delivering up to time.

If the works are overcrowded, this contingency should have been foreseen before accepting excess orders, although the working staff can generally be quickly reinforced.

With the official staff it is, however, another matter when temporary spells of urgent work have to be dealt with, such as—

1. Combined plant trials at client's works, or
2. Survey of site where a scheme is to be tendered for, or
3. Urgent tender to be completed within a limited space of time (office work entirely).

In any of the three cases above, the energies and attention of a large portion, if not the whole, of the official staff are required, and it is at such times that *temporary assistance* may be called in.

It is usual to engage responsible officials, departmental or otherwise, for a term of weeks, months or years, as the case may be, and they fulfil their obligations for the stated period under a contract. Under present day severity of competition, which in no wise is likely to lessen, changes in the staff are frequent, owing to the fact that many a rising junior will resign his post for one only slightly better in point of salary, when he sees a chance of getting out of a rut with advantage. Such a change is bound to disorganise the routine of the department affected, until his successor is initiated into the methods in favour with the firm, and the problems in hand. During the interregnum, clients grow impatient at inattention to their needs, and so the cycle repeats itself at times regularly, at others most inconveniently—the result being that for short varying periods the staff of the firm in question is quite inadequate to carry on its business and correspondence in step with the orders in hand. Delays in some or all departments ensue, and it is difficult for the head office staff to make up time by working extra long hours, particularly when salaries are not sufficiently augmented, if at all, in proportion.

It seems, therefore, that there is a decided field for the introduction of *temporary assistance* as a recognised measure when completion of work is pressing or overdue. It is a measure resorted to by other trades and callings under somewhat similar circumstances, but the practice does not seem to have been applied to electrical engineering.

Provided that the man available is duly qualified in the branch or branches of work he professes to understand, and is quick and accurate in his methods, there is no reason why several firms should not call in such assistance to tide over rushes of work without increasing their permanent staff extravagantly; the remuneration would naturally be higher for short periods, and payable per week or even per day.

The question arises whether there would be an adequate supply of such men, unattached to any one firm and willing to undertake work within their own sphere of knowledge for uncertain periods throughout the year with a problematical income.

Probably not at the commencement, for it would chiefly appeal at such a stage to men with means sure but small enough to necessitate their doing some work in which they were versed, in order to enjoy living as compared with existing. Provided that their credentials for work and character were beyond suspicion, there is little question that an equal income could be earned in 250 days or less per annum, as compared with 300 days per annum in a fixed situation.

The broadening of ideas and experience would be of immense benefit to anyone so engaged, not only in his own pet subjects, but in others which it would be unlikely he could ever handle in the ordinary course of routine. Sooner or later, too, he would probably receive the offer of a permanent post by some official recognising his "forte" in some particular department or study, carrying with it a salary commensurate with his own ideas and ambition.

It would be essential, of course, that such an engineer should live within easy radius of the industrial centre within which his energies were to be sought, so that his aid might be summoned speedily and easily.

When success has attended the efforts of such a man who has risked the loss of a slow but reasonably sure position in order to gain greater experience and higher status, or of those who kill time to some useful purpose for the sake of advancement amongst their fellows, then such a course may be freely entered upon by many without undue risk

when a certain personal connection has been formed, and the "ennui" following upon bad trading, bad debts, managerial and departmental changes, and generally small hope in the future for advancement vanishes with a sense of personal change for the better under one's own initiative and with a wider circle of confrères.

It has been truly said that "opportunity occurs once in a lifetime to every man"; the wise man is he who determines promptly to close with that opportunity.

PATERSON'S PATENT FIRE-RESISTING CABLE.

We recently had the pleasure of witnessing, at the works of Messrs. Johnson & Phillips, Ltd., a remarkable series of experiments on a new fire-resisting cable, which is being introduced by this firm. As our readers are aware, attempts to produce a satisfactory cable of this type have been made in various quarters, with more or less success. Messrs. Johnson & Phillips themselves have been experimenting in this direction for several years, and the cable which they are now manufacturing appears to afford a complete solution to the problem, as will be seen from the extraordinary tests described below, which it successfully endured in our presence.

Obviously, lead-covered wire is useless for fire-resisting purposes, so that we are compelled to employ rubber or other more or less inflammable waterproof materials to provide the necessary insulation resistance; when decomposed by heat, these materials give off highly inflammable gases, which are readily ignited. In the Paterson cable, the copper conductor is covered first with a layer of asbestos paper; next comes the ordinary pure and vulcanised rubber insulation, followed by several laps of Manila paper of the highest quality, impregnated with a special fluid, which renders it not merely uninflammable, but, to some extent, a fire extinguisher. Over the paper there is a strong flexible braiding of fine steel wires, covered with several laps of the above-mentioned paper; and over all the cable is braided with impregnated jute, and finished off with red or black fire-resisting compound.

Samples of this cable were subjected to the following extremely severe tests:—

1. The cable was heated over a Bunsen flame for half an hour, while a pressure of 220 volts was maintained between the steel braiding and the copper conductor, in parallel with an incandescent lamp, which remained burning the whole time, thus showing that no short-circuit took place. The cable was then struck three blows with a 2-lb. hammer, without apparent effect. The insulation resistance between the copper and steel was 75 megohms, measured at 500 volts. The cable was beaten flat, and finally short-circuited with three more hammer blows.

2. The cable was heated as before, and the insulation resistance between copper and steel was measured at intervals, at 500 volts, with the following results:—After 18, 26, 36 and 40 minutes, 75 Ω on each occasion. The sample was then tested with high voltage, but failed to break down with 3,000 volts.

3. The copper conductors in a sample were replaced by arc lamp carbons, and an arc was struck in its interior, with a current of 60 amperes at 200 volts; after the arc had been maintained for 20 minutes the cable was red hot, but there was no flame. The current was raised to 90 amperes for five minutes, but there was still no flame.

4. A similar experiment was carried out on a sample of ordinary V.I.R. braided cable, which burst with a loud report in less than 10 seconds.

5. A sample of Paterson's fireproof cable, No. 3/22 S.W.G., was overloaded with 80 to 100 amperes; the conductor fused in about 2 minutes, the insulation and protection remaining intact.

6. A piece of ordinary 3/22 cable was similarly overloaded; after a few seconds the wax compound in the braid began to melt, followed by the rubber, and in 1¼ minutes the cable was in flames.

In another instance a sample of Paterson's cable was tested before heating, giving 6,000 Ω; it was then placed in a Bunsen flame for 30 minutes, after which it was tested, giving 400 Ω; then it was struck with a hammer three times whilst hot, and replaced in the flame, the insulation resistances after each blow being 60, 40 and 30 Ω respectively (E.M.F. of testing battery, 500 volts).

One could hardly ask for more drastic tests than the foregoing, and the makers are to be congratulated on their success.

There are many positions where such cable should prove exceedingly useful: for example, for the connections between motors, &c., on electric trains; in situations where inflammable goods are stored; at the back of switchboards; in the neighbourhood of fires, as in hotel kitchens, bakehouses, hospitals, &c.; in textile factories, iron works, on board ship, and so on. It will be observed that the cable is not only proof against internal fire, but also against external heating, so that in the case of a fire occurring in a building wired with these cables, the electrical circuits would probably not be interrupted for a long period—a feature which might be of the utmost importance. The cable is made in all sizes, and does not cost much more than high-class wire of the ordinary type.

HIGH-PRESSURE D.C. TRANSMISSION.

The recent revival of interest in the series system of direct-current power transmission has brought certain considerations forcibly to the front. Already in our issue for October 14th, 1904, *i.e.*, two and a half years ago, we published the tests now again cited, which indicate that certain insulating materials will stand twice as high an effective voltage per unit of thickness when tested by direct current as when tested by 50-cycle alternating current. The whole issue of the commercial advantage of the continuous-current series system for power transmission rests on this point; or rather, this is one point which it is absolutely necessary to establish. Hence it is the more surprising that after the lapse of so long an interval, we are not as yet in possession of confirmatory data from many sources. Here is a matter which could with advantage be investigated by the National Physical Laboratory. In fact, in Mr. Rayner's paper recording the results of some investigations at the National Physical Laboratory (*Journal* Institution Electrical Engineers, Vol. 34, p. 613), are given the results of tests of the dielectric strength of air and of certain materials when subjected to two different periodicities—namely, 36 and 50 cycles. The dielectric strength increased very distinctly with the frequency, but there appeared no conclusive ground for knowing that this might not have been due to change of wave form. Indeed, everything on record in this line of work emphasises the danger of drawing hasty conclusions.

It would appear probable that the 2:1 ratio will be fairly substantiated for many materials and conditions, but there must be no room for reasonable doubt, since these figures will form the basis for the design of the insulation of transmission cables.

There is ascribed to the direct-current system of working the further advantage that there is no dielectric hysteresis loss in the material of the insulation. Here, again, we are touching upon a subject which has been much neglected, considering its great importance. The term dielectric hysteresis was suggested by Steinmetz in 1892. To quote from that author's "Theory and Calculation of Alternating Current Phenomena," Second Edition, p. 145:—

"While the laws of magnetic hysteresis are fairly well understood, and the magnitude of the effect known, the phenomenon of dielectric hysteresis is still almost entirely unknown.

"It is quite probable that the loss of power in the dielectric in an alternating electrostatic field consists of two distinctly different components, of which the one is directly proportional to the frequency, analogous to magnetic hysteresis, and thus a constant loss of energy per cycle, independent of the frequency; while the other component is proportional to the square of the frequency—analogous to the loss of power by eddy currents in the iron, and thus a loss of energy per cycle proportional to the frequency."

A good many physicists have worked at the problem since that time, but the practical man is still left without the necessary data for his purpose. I^2R losses in the insulation are frequently ascribed to dielectric hysteresis. This is a very natural error, in consequence of the rapid rate at which the true ohmic resistance of most insulating materials decreases

with increasing temperature; 6° to 10° C. temperature increase suffices, in most cases, to halve the insulation resistance. Thus we may, to fix ideas, say that the insulation resistance is halved for every 8° temperature increase. A 40° C. temperature rise is thus likely to halve the insulation resistance five times, the value at the 40° C. higher temperature being of the order of $\frac{1}{2}\frac{1}{5} = \frac{1}{32}$, or, say, something like 3 per cent. of its original value.

Now, there will always be a minute current flowing through insulations subjected to differences of voltage, and this I V loss, small as it may be initially, is located in a substance of very low thermal conductivity. If the internal portions heat ever so little, the consequent decrease in insulation resistance will be followed by a greater current, a greater loss, and increased rate of heating, and this will be concentrated at the weakest point. This occurrence will often be sufficient to account for the breakdown, and it will not be any less serious with direct current of a given effective voltage.

As to the additional heating due to "dielectric hysteresis," and not occurring in direct-current systems, the practical engineer has but very scanty data for his work. The National Physical Laboratory could render a service of great value by carrying out a series of exhaustive tests on these points. We must have some better explanation than has yet been vouchsafed, and a better supply of experimental data, before we can feel reconciled to the plan of cutting down the insulation thicknesses in cables for direct-current series systems of power transmission. As it is precisely in the cost of the transmission line where this system makes up for its greater cost in other directions, notably at the generating station, it is clear that the commercial utility of the system is dependent upon whether or no 3,000 volts per millimetre thickness of insulation gives a sufficient safety factor for cables for a 50,000-volt plant of this type.

This matter of the safety factor which should be provided for cables employed in systems of different types, in itself constitutes a problem of great difficulty. For 11,000-volt three-phase transmission systems, at least double normal working pressure is invariably required to be sustained for one hour by the cable as installed. Are we to take a higher or a lower safety factor for cables for direct-current high-tension power transmission?

The inductance of the high-tension series line itself will be relatively small compared with the inductance of the machines and apparatus comprised in the series system. The inductance of a set of sub-station series motors of 7,000 KW. aggregate capacity on a line of, say, 100 miles length, will be of the order of at least 500 henrys. It is hardly reasonable to suppose that human ingenuity can provide against occasional interruptions of the circuit while carrying full load current. Let us take this current at 70 amperes for a voltage of 100,000, and let us assume, for purposes of argument, that the current is reduced in half a second from 70 amperes to zero, *i.e.*, that it is reduced at the *average* rate of 140 amperes per second. Then the reactance voltage amounts to—

$$\frac{2\pi}{1{\cdot}41} \times \frac{0{\cdot}25}{0{\cdot}50} \times 500 \times 70 = 100{,}000 \text{ R.M.S. volts.}$$

At the instant of breaking, however, the rate of decrease of current will be much greater than the average rate, and the momentary voltage may thus be far in excess of the above figure.

Few of us have escaped the experience of sustaining through our bodies the discharge of the field circuit of dynamos excited with direct current. Even in the case of small machines, the result is of an order of violence corresponding to very many times the normal pressure across the field coils. Recollections of this sort will serve to confirm mathematical estimates of the order of magnitude of these induced voltages. It is to be anticipated that should a direct-current series system on a really large scale ever be undertaken, "subtleties" will be much more in evidence than has been the case with alternating-current transmission systems. It is very much to be doubted whether the factor of safety of two, which has generally sufficed for alternating-current plants, will not have to give place to considerably higher values in direct-current series power transmission systems when underground cables are used. In this case the chief point of alleged commercial advantage, namely, the transmission line, will have to come in for radical reconsideration.

In Mr. Field's highly illuminating paper, read before the Glasgow Section of the Institution of Electrical Engineers some few years ago, the frequent occurrence of breakdowns on direct-current systems was considered from the standpoint of a potential wave sent into a circuit on closing a switch. As this wave of potential advances into the new circuit, it is shown how the "potential front," in entering the apparatus in the circuit, subjects the insulation between turns and between layers to stresses many times in excess of the normal stresses. It is not necessary that the circuit be actually completely opened or completely closed, for, to quote from the paper:—

"These potential fronts may be created at any point of the circuit by suddenly altering the potential at that point, *e.g.*, by short-circuiting, grounding, and the like."

What could be more pertinent to the subject under consideration than the above statement? To cut out motors in the series system they are short-circuited. If it is a sub-station containing a couple of 4,000-volt motors which is cut out of service, the instantaneous disturbance of the system is comparable to an abrupt and large change in the inductance of the circuit, and the nature of the consequences is well known.

The possible immunity of the Thury systems, as so far installed, from troubles of this sort is not reassuring, for they are all small systems, ranging from 300 to 4,000 KW. total capacity each. In only two of them is the line pressure over 15,000 volts, and in only one of them are the individual generators of more than 400 KW. rated capacity.

Thus the inductance effects and the total pressures involved are in no sense commensurate with the values which are being discussed in connection with prospective work, and it behoves engineers who contemplate going in for larger work with this system, not to disregard the consequences of cutting the insulations too fine.

THE PRESENT TENDENCY OF CHARGING FOR ELECTRICITY.

By W. A. TOPPIN, A.M.I.E.E.

In considering the changes that have been made by many supply authorities in their methods of charging, one is struck by the marked tendency towards the use of some system that takes into consideration the period of the day during which the supply is required. There is a great diversity in the systems adopted as will be seen in the following table, and several of them must be rather difficult to work under practical conditions. It must be a great disadvantage both to the supply authority and to the consumer to have frequent changes in the method of charging for electricity. A system is perhaps tried in one town that has previously been adopted in another town, and discarded as unsatisfactory. In order to avoid this, it would be a good thing for the Municipal Electrical Association to take this matter up at its annual Convention. The views of prominent engineers could then be ascertained and two or three systems chosen that could be applied to all classes of consumers. These systems could then be strongly recommended to all supply authorities, and more uniformity secured than exists at present. It would be understood that these systems had given complete satisfaction to both consumer and supply authority, and were the best yet devised. The price charged per unit would, of course, vary in different towns according to the generating costs, amount of competition, and other factors to be taken into consideration.

The following is a list of towns that have made, or propose to make, alterations to the system in use (and about which notices have appeared in the electrical press) during the past three months:—

Name of Supply Authority.	System of Charging.	Remarks.
Blackpool ...	Double tariff.	To encourage the use of radiators and heaters during the day.
Battersea ...	Double tariff.	
Carlisle	Double tariff for power users.	High rate, 3½d. per unit, only in operation during heavy lighting load hours from Sept. 15th to April 15th. At any other period, low rate, 1d. per unit.
Colne	Reduced rate for restricted hours' supply to power users.	To prevent overlapping of power and lighting demands.
Cheltenham .	Graduated discounts according to number of units used per quarter.	Consumers to guarantee a minimum consumption of 4,000 units per annum before being allowed these special discounts.
Derby	Uniform power rate of 1d. per unit if current is used throughout *whole day*.	
Erith	Double tariff for power and lighting.	High rate 4½d., and low rate 1½d. per unit. The consumption of energy for lighting purposes not to exceed 20% of the total annual consumption.
Enfield	Maximum demand for lighting and power or restricted hour supply, 1½d. per unit.	Demand indicators calibrated in number of 8-C.P. lamps, to render it simpler for the consumer to understand.
Gravesend...	Double tariff for power purposes.	High rate, 5d. per unit, 5 p.m. to 10 p.m. during winter months, and 6 p.m. to 10 p.m. during summer months; 1d. per unit, low rate. Large number of motors added without appreciably increasing the maximum load on the station.
Hanley	Maximum demand for lighting and power purposes.	Demand indicator in every consumer's premises.
Leeds..... ...	Reduced price to power consumers who use 1,000 B.T.U. per H.P. of their maximum load.	This system takes into consideration the load factor of the consumer.
Southampton	Consumers taking an all-night supply and using more than 50,000 units per annum, specially reduced rate.	Adopted to encourage the all-night use of electricity in railway stations, goods yards, and amongst similar consumers.
Stafford	Graduated discounts according to number of units used per quarter.	From 1,400 to 2,000 units, 10% discount; from 2,000 to 3,000 units, 12% discount; over 3,000 units, 15% discount. The price charged per unit remains the same in each case.
St. Helens...	Graduated discounts to power users.	Discounts varying from 5% to 25%, according to number of units used per month.
Warrington .	Graduated scale of charges according to consumer's load factor. Power users only.	Load factor per cent.: 15, 1·8d.; 20, 1·55d.; 25, 1·42d.; 30, 1·25d.; 35, 1·12d.; 40, 1·0d.; 50, ·94d.; 60, ·88d., 70, ·82d.; 80, ·76d.; 90, ·70d.
Wednesbury	Flat rate to consumers undertaking to use electricity for a certain period each day.	The period each day that the consumer must agree to use the current being from dusk to 11 p.m.
West Ham...	Hour meter system. Special rates for long hour-power consumers.	Arc lamps hired to consumers at £8 4s. per lamp per annum for 800 hours' use, and for every hour in excess, 2½d. The charge includes energy, trimming, carbons and lamp. Meter rent, 1s. per quarter. For small shopkeepers, 4-light fitting complete £4 10s. per annum of 800 hours, and 1¼d. per hour in excess. Consumer must sign two years' agreement.

It will be seen that out of the seventeen supply authorities mentioned, no fewer than fourteen take into consideration the number of hours per day a consumer uses electricity. Only three of them have adopted the policy of offering special rates to large consumers irrespective of their load factor. The double-tariff system has been adopted by five, and two are trying the restricted-hours supply to power users. The writer is not aware as to how the power consumer's load factor is arrived at in Warrington. A simple method would be to put in the consumer's premises a maximum demand indicator, multiply the reading obtained by the number of hours per quarter, and thus arrive at the maximum number of units the consumer could use in that period. By comparing the actual number of units registered on the meter with the maximum possible, the consumer's load factor could be arrived at. The system referred to certainly seems a very fair one, and treats the large and small consumer on the same footing. The sliding scale or graduated discount systems that specially favour the large consumer (who is not necessarily a good long-hour consumer) are apt to cause complaints from the small consumers, and prevent their number from increasing very rapidly.

The great eagerness displayed by supply authorities in obtaining power consumers, and the very low rates offered, seem to the writer to be carried to the extreme in some cases. Generating stations were, as a rule, originally erected with the idea of supplying the lighting consumer only, but in time, the desire to find a class of consumer who would use electricity during the hours of daylight, led to the rush for the power consumer. Exceptionally low rates were offered, and motor-driven machinery of all descriptions were connected to the mains. In many cases motors having violently fluctuating loads caused the supply authorities to spend much time and money on various arrangements for keeping the pressure steady enough for their lighting consumers. No doubt if central stations had been originally arranged for the power consumer, the lighting consumer would now have special rates to encourage the evening load, and keep the engines working at as near full load as possible for 24 hours each day.

Considering the station load curve for a day in December, as shown in fig. 1, it will be seen that there is a good power load. The lighting load is shown shaded at A, and the overlapping

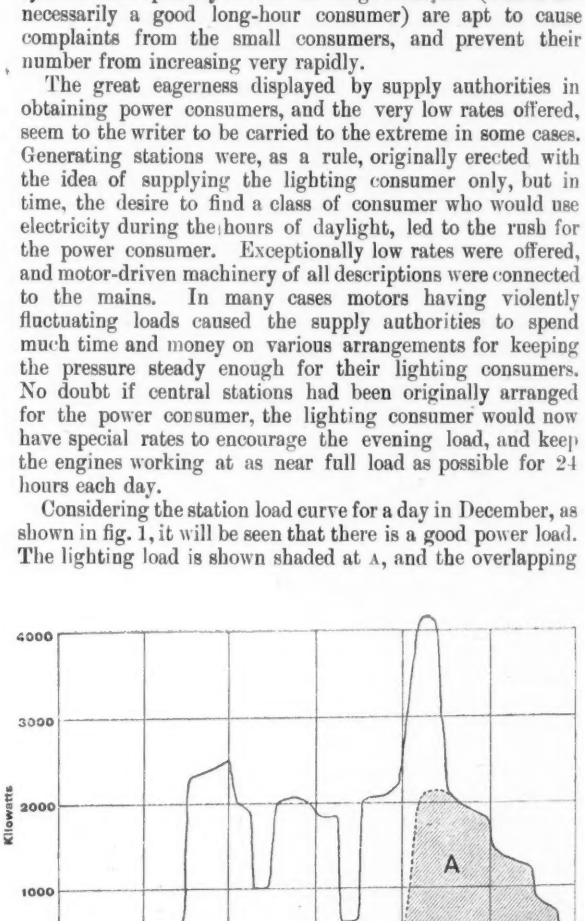


FIG. 1.

of the demands of these two classes of consumers causes the huge peak shown. A generating station having plant of 2,000 KW. capacity would be large enough to supply either the power or lighting consumers separately, but the two combined necessitate generating plant of 4,000 KW. capacity. The power consumer can, therefore, as justly be charged at a high rate during the hours of peak load as the lighting consumer.

Where the large works or factories cannot be induced to agree to a restricted hours' supply, it appears that the double tariff system is the next best arrangement. Dealing with the smaller power and lighting consumer, the best plan seems to be to fix a maximum demand indicator in every consumer's premises, and charge either a high rate for the first hour's use of maximum demand, and then a low rate, or on a graduated scale according to the load factor. In many towns the maximum demand system and the flat rate system are both in use, and the consumer has the choice. The short-hour consumer naturally chooses the flat

rate, and frequently does not pay his fair share of the standing charges. Those consumers who never require energy during the hours of peak load, might be excepted from the above rule and charged on a low flat rate.

At the annual meeting of the Municipal Electrical Association in 1905, Mr. Sinclair read an excellent paper on "The Load Factor; its Effect upon an Electricity Station." Mr. Newington, in his presidential address, referred to the restricted hours' system as having been adopted in Edinburgh, and gave the following table, showing what a very poor load factor many power consumers have :—

Type of Consumer.	Total H.P. installed.	Full load hours per day.
Elevators	610	0·9
Butchers and bakers	180	1·27
Printing works	1,327	1·52
Breweries	247	1·13
Joiners and builders	1,057	1·85
Engineering works	981	2·08
Laundries	40	2·87
Aerated water works	28	3·27

Mr. H. Kilgour also contributed a paper that year on "Notes on Costs and Tariffs for Electric Supply," in which he pointed out that if one class of consumer is specially favoured, it may become more important than all the remaining classes taken together, and unless the tariff is revised, may lead to the supply being given at an absolute loss. This substantiates the remarks made by the writer regarding the very low rates offered to power consumers in some towns. A town that has a very small number of possible power users is quite safe in charging very low rates for power, but one where there are large possibilities amongst this class of consumer, requires to take the future into consideration and arrange the charges accordingly. Changes in prices or systems of charging require to be made with great caution, as whilst it is easy to reduce the price to any particular class of consumer, it is quite another matter to raise the price again.

PUBLICITY: OR, HOW I BOUGHT A 5-H.P. MOTOR.

(Based on Facts.)

By BEN FRANK.

I was in want of a 5-H.P. motor for driving a small machine, and sent the following inquiry to a large Americanised motor manufacturing company :—"Kindly quote me, by return of post if possible, for a 5-H.P. shunt-wound motor, to run at about 1,200 R.P.M. on a 200-volt continuous current circuit, complete with sliding rails and pulley."

In reply to the above I received the following :—"We are much obliged by receipt of your valued inquiry for motors, and enclose you herewith our Motor Enquiry Form, and on receipt of this duly filled in we shall be able to quote you by return of post."

This form was one of the new Publicity documents, and contained about 125 columns or spaces to be filled in with various particulars, and covered every conceivable detail that might apply to a motor of any description, continuous or polyphase. I thought it best to fill this form in, although I could give no more information than was contained in my original inquiry.

By return of post I received the following :—

"We are duly in receipt of yours of yesterday enclosing our Motor Enquiry Form filled in, which we have handed over to our Estimating Department, who will quote you in due course. As you are in the market for motors, we enclose you herewith our pamphlet on Motor Driving, which will show the absolutely unique position we hold in the motor world. There is no branch of this extensive industry which we have not touched, and the services of our vast technical staff are fully and freely at your entire disposal. Awaiting your further inquiries, we are, &c."

After waiting for two days, I sent a postcard to remind the firm that I had not received the quotation yet, and received the following reply :—

"Your postcard came duly to hand, and we regret that, owing to extreme pressure of business in our Estimating Department, your inquiry has not yet reached its turn. We receive thousands of inquiries daily for motors, and these must, of course, be taken seriatim. We are now within a few hundred of yours, and have every hope of reaching it to-day. We take the liberty of enclosing herewith our pamphlet on Electric Ventilation. We know that 99 per cent. or more of the offices in London would be equipped with our electric fans if we had the chance of personally discussing the matter with the tenants, and if, after perusing the enclosed, you would like a call from us, we will send round one of our salesmen who will go fully into the matter with you, and positively convince you that it is physically impossible for you to successfully carry on your business without one of our electric fans on your desk."

Then, after a day or two, I sent another postcard, saying "Do please let me have that quotation by return." But instead of the estimate I got the following :—

"We regret that our quotation has not yet reached you, but the whole of our engineering staff have been working night and day on it, and hope to have it completed by midnight to-night, and it shall be sent round by special messenger in the morning. We find that we have not yet heard from you on the subject of electric fans. We have tried our best to make the advantages clear to you, and to show you how much more life would be worth living during the hot weather, if your office could be kept cool and fresh by electric fans. 'If we had the descriptive powers of Sir Walter Scott and the force of Sandow, we might succeed in making the thing stronger, but being simply salesmen with nothing but our knowledge of the real beauty of fans to tired overheated humanity, we can only repeat that it is our firm conviction that you cannot possibly be happy until you get them."

By the same post I received also an appeal from the supply company, who had evidently been told by the motor company that they had had inquiries from me for motors, and that in all probability I had a private plant. The circular was to the following effect :—

"Why make your door a dump-heap? Customers will not push into your office past dusty, greasy stokers; and coal and ash carts on your curbstones do not look well. Let us do the shovelling. Let us make the noise, grease, smells and dirt, miles away from your office. That is our business; yours is to keep clean, cool and quiet. We are experts in the shovelling business. Our men like it. It is second nature to them. On receipt of the enclosed card, one of our salesmen will be round by motor-car in five minutes."

Another postcard from me to the motor company, saying that unless I got the quotation by return I should go elsewhere for my motor, brought forth the following reply :—

"We know how tired you must be waiting for that quotation, but we can assure you that when you get it you will be delighted. No motors are like our motors. Every horse-power given by our motors is worth at least 5 H.P. given by anyone else's. What about arc lamps? Surely you want some arc lamps, and we enclose herewith our bulletin which tells you all about them. Electric light is one of the great discoveries that go far towards making this twentieth century life of ours better worth living—fuller of refinement, comfort and culture."

Just as I had finished reading this, my clerk brought in a traveller's card. He represented a motor maker. I don't usually see travellers, but just as a drowning man clutches at a straw, so I grasped the chance of seeing this man.

"Do you make motors?" I asked. "Well, then, can you give me a quotation for a 5-H.P. shunt-wound motor, 200 volts, 1,200 R.P.M.?"

"Oh, yes," he said, "I can give you a quotation for that now." And in about two minutes he had figured it out from his list, and taken off the discount.

"Now, then, how soon can you deliver?"

The traveller turned up his stock list, and said, "We have one in stock—could send it off to-day if I wire the works."

"You are not an engineer, I suppose, just a traveller, and know nothing about the technical details of these motors. Don't know a motor from a rheostat, I suppose?"

"Oh, yes," he said, smiling, "I am an engineer, and can tell you anything you like about the motor."

The result was that this representative took the order with him, telegraphed for the motor, and it was in my place and running within two days.

I am still receiving weird pamphlets and bulletins from the motor company, and I suppose their engineering staff are still working night and day on that quotation, for I have never received it.

The International Glow Lamp Syndicate.—The International Glow Lamp Syndicate, which bears the title of the Verkaufsstelle Vereinigter Gluhlampen Fabriken of Berlin, is reported to have had a turnover of 31,400,000 lamps in the year ended March 31st, 1907. This compares with a total sale of 30,000,000 lamps, in round figures, in the preceding year. It has been possible for the syndicate in the past financial year to reduce the number of outside competitors by the conclusion of agreements with three of these firms. These are the Bavarian glow lamp factory of Ludecke & Co., of Lechhausen, near Augsberg, the firm of Zschocke & Co., of Dresden, and the Anker glow lamp factory in Berlin. As independent outsiders there now remain the Union glow lamp factory at Finsterwalde, the Radium glow lamp factory at Wipperfurth, and the Allgemeine glow lamp factory in Berlin; the latter only being in course of establishment at the present time.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

11,742. "Improvement in cell testers." P. WATSON. May 21st.

11,754. "Improvements in telephone transmitters." W. G. HEYS. (General Acoustic Co., United States.) May 21st. (Complete.)

11,774. "Improvements in central battery telephone exchange systems." J. A. ROMER. May 21st.

11,780. "Improved electric cable." W. E. RICHARDS. (The Electric Loop Cable Co., United States.) May 21st.

11,786. "Improvements in electrical devices and apparatus." F. B. COOK. May 21st.

11,794. "Improvements in or relating to the control of electric motors." J. G. V. LANG. May 21st.

11,808. "Improvements in telephonic apparatus." E. A. GRAHAM. May 21st.

11,814. "Improvements in connection with electric circuit-breakers." W. H. SCOTT. May 21st.

11,823. "Improvements in devices for amplifying electric currents." H. W. LAKE. (J. S. Stone, U.S.) May 21st. (Complete.)

11,828. "Improvements in transformers for use in making electrical measurements." SIEMENS BROS. & Co., LTD. (Siemens & Halske Act.-Ges., Germany.) May 21st. (Complete.)

11,850. "Rotary intermittent electric sign switch." A. BOTTING and W. H. BOTTING. May 22nd.

11,872. "Improvements in or relating to dynamo-electric machines and motors." SIEMENS BROS.' DYNAMO WORKS, LTD., and M. KLOSS. May 22nd.

11,873. "Improved method of and means for altering the working speed of polyphase motors." SIEMENS BROS.' DYNAMO WORKS, LTD., and H. B. POYNDER. May 22nd. (Complete.)

11,874. "Improvements in or relating to combined electrical-mechanical systems for the storage of power." SIEMENS BROS.' DYNAMO WORKS, LTD., and H. B. POYNDER." May 22nd. (Complete.)

11,894. "Improvements relating to electric incandescent lamps." C. PAULI. May 22nd. (Complete.)

11,911. "Improvements in electric arc lamps." H. W. HEADLAND and F. PLUTTE. May 22nd.

11,917. "Improvements in electrodes for resistance furnaces." R. ROCHLING, J. SCHOENAWA and W. RODENHAUSER. May 22nd. (Complete.)

11,926. "Improvements in controller mechanism for electrically-operated cranes, lifts and the like." BRITISH THOMSON-HOUSTON Co., LTD. (Allgemeine Elektricitats Ges., Germany.) May 22nd.

11,940. "Apparatus to measure the quantity of electricity passing through an X-ray tube." A. H. PIRIE. May 23rd.

11,952. "Improved electrical fuse." A. G. CHARTERS and J. G. JONES. May 23rd. (Complete.)

11,979. "Supported carbon for electric arc lamps." DEUTSCHE BECK-BOGENLAMPEN G.m.b.H. and H. BECK. (Date applied for under Patents Act, 1901, January 29th, 1907, being date of application in Germany.) May 23rd. (Complete.)

11,984. "Improvement in electrical motor starting and regulating switches." T. L. R. COOPER. May 23rd.

12,010. "Improvements in automatic electric boosters." R. C. ROBERTS and P. L. RIVIERE. May 23rd.

12,020. "Improvements in and relating to apparatus for use in space telegraphy." BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) May 23rd.

12,043. "Improvements in and relating to electro-signalling by means of electric waves." A. ORLING. May 24th.

12,050. "Improvements in or relating to dynamo-electric machines and motors." SIEMENS BROS.' DYNAMO WORKS, LTD., and M. KLOSS. May 24th. (Complete.)

12,053. "Improvements in ventilating dynamo-electric generators, motors and the like." SIEMENS-SCHUCKERTWERKE G.M.B.H. (Date applied for under Patents Act, 1901, May 31st, 1906, being date of application in Germany.) May 24th. (Complete.)

12,065. "Improvements in holders for incandescent electric lamps." M. FAVERO. May 24th.

12,069. "Improvements in and relating to mariners' compasses." J. C. DOBBIE. May 24th.

12,072. "Improvements in or relating to electric motor equipments for marine propulsion. H. A. MAVOR and MAVOR & COULSON, LTD. May 24th.

12,079. "Electrically-heated steam radiators." R. N. CUNNINGHAM and A. BRACKENSIECK. May 24th.

12,081. "Improvements in electrically-propelled vehicles." W. N. STEWART. May 24th.

19,089. "Improvements in and relating to internal combustion engines." BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) May 24th.

12,090. "Improvements relating to alternating-current commutating electric machines." ALLGEMEINE ELEKTRICITATS GES. (Date applied for under Patents Act, 1901, May 25th, 1906, being date of application in Germany.) May 24th. (Complete.)

12,129. "Improved supports for electric incandescent lamps." F. P. DRIVER. May 25th.

12,135. "Improvements in magneto-electric ignition apparatus." W. ROOS. May 25th. (Complete.)

12,150. "Improvements in electric typewriters." J. LEMBLE. (Date applied for under Patents Act, 1901, May 25th, 1906, being date of application in Germany.) May 25th. (Complete.)

12,152. "Improvements in and relating to electrical house terminal boards and cut-outs." S. H. PENNING. May 25th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1906.

STREET OR STATION INDICATOR FOR ELECTRIC TRAMCARS AND SUBWAY CARS. D. Livingstone and W. Dickinson. 29,452. December 27th.

ELECTRICITY METERS FOR TESTING PURPOSES. Isaria-Zahlerwerke Ges. 29,494. December 27th. (Date applied for under International Convention, December 27th, 1905.)

MEANS OR APPARATUS FOR SUPPLYING ELECTRIC CURRENT TO TELEPHONIC APPARATUS. E. A. Graham. 1,714. January 23rd.

BATTERIES OF ELECTROLYTIC CELLS. R. H. F. Finlay and A. H. Finlay. 1,716. January 23rd.

CHARGING ACCUMULATORS. E. de Marcay. 8,345A. April 6th. (Date applied for under International Convention, January 24th, 1906, originally included in No. 8,345/06.)

ELECTRICAL WIRE CONDUIT SURFACE OUTLET BOX. Aberdeen Electrical Engineering Co. and R. G. Botting. 9,142. April 18th.

ELECTRIC SHIP LOG. E. V. H. Rizzo. 9,328. April 20th.

MANUFACTURE OF CEMENT JOINTS FOR INCANDESCENT ELECTRIC LAMP FILAMENTS. A. Just, F. Hanaman, H. Landesberger, O. Salzman, and firm Vereinigte Electricitäts Akt.-Ges. 9,349. April 20th.

GALVANOMETERS. J. Richard. 9,351. April 20th.

ELECTRO-PNEUMATIC CHANNELERS. H. H. Lake. (Ingersoll Rand Co.) 9,594. April 24th.

ELECTRIC ARC LAMPS. E. R. Grote and M. V. Ely. 9,784. April 26th.

ELECTRIC FUSIBLE CUT-OUTS. O. L. Peard. 9,789. April 26th.

ALTERNATING-CURRENT COMMUTATOR MOTORS. H. C. E. Jacoby. 9,858. April 27th.

ELECTRO-AUTOMATIC MECHANISMS FOR DISPLAYING ADVERTISEMENTS. W. B. Johnson. (F. B. P. de Vara.) 9,951. April 28th.

LINING FOR ELECTRIC OR OTHER FURNACES AND METHOD OF PREPARING THE SAME. H. L. Hartenstein. 10,161. May 1st.

TRANSLATING SYSTEMS FOR ELECTRIC TELEGRAPHY. I. Kitsee. 10,249A. May 2nd. (Date applied for under Rule 5, Patents Rules 1905, May 2nd, 1906.)

CONTROLLING GEAR FOR ELECTRIC CRANES AND LIKE HOISTING APPARATUS. W. Dixon. 10,630. May 7th.

INDUCTION MOTORS. J. E. Raworth. (A. V. Clayton.) 11,238. May 14th.

ROTARY MEMBERS FOR DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. (General Electric Co.) 11,986. May 22nd.

COST INDICATOR APPLICABLE FOR ELECTRICAL METERS. J. W. Record and H. Bevis. 12,010. May 23rd.

END CONNECTIONS FOR CONDUCTORS ON FIELD MAGNETS OF ALTERNATE-CURRENT GENERATORS. M. Walker. 13,078. June 6th.

ELECTRIC RESISTANCE DEVICES. British Thomson-Houston Co. (General Electric Co.) 15,985. July 14th.

DIRECT-CURRENT ELECTRIC SUPPLY SYSTEMS. J. S. Highfield. 16,820. July 25th.

POWER PLANTS FOR THE PRODUCTION OF ALTERNATING ELECTRIC CURRENT BY STEAM ENGINES. F. W. Howorth. (Maschinenfabrik Oerlikon.) 21,952. October 14th.

ELECTRIC TRANSFORMER FURNACES. O. Frick. 22,519. October 11th. Date applied for under International Convention, December 18th, 1905.

ELECTRICAL WINDING MECHANISM FOR CLOCKS. J. Steiger and J. Besancon. 26,086. November 17th.

ELECTRICAL COMMUTATION DEVICES. W. S. Franklin and S. S. Seyfert. 7,248A. March 26th. (Date applied for under Rule 5, Patents Rules 1905, March 26th, 1905.)

OSCILLATING ELECTRIC MOTORS. J. D. H. Andrews. 7,752. March 31st.

WIRELESS TELEGRAPHIC AND TELEPHONIC SYSTEMS. S. Eisenstein. 7,942. April 2nd.

RENDERING OF OVERHEAD ELECTRIC WIRES "DEAD" IN THE CASE OF FRACTURE. R. E. Wood and H. Wood. 10,148. May 1st.

BRUSH-HOLDERS FOR DYNAMO-ELECTRIC MACHINES. Morgan Crucible Co. and C. W. Speirs. 10,220. May 1st.

PROCESS FOR THE PRODUCTION OF STEEL, AND AN ELECTRIC FURNACE FOR CARRYING OUT THE SAID PROCESS. G. Gin. 10,396. May 3rd. (Date applied for under International Convention, May 3rd, 1905.)

ELECTRICAL SWITCHING DEVICES FOR TELEPHONIC PURPOSES. H. H. Lake. (Stromberg-Carlson Telephone Manufacturing Co.) 10,549. May 5th.

COMMUTATORS FOR DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. (General Electric Co.) 10,795. May 8th.

MACHINES FOR USE IN THE MANUFACTURE OF INCANDESCENT LAMPS. British Thomson-Houston Co. (General Electric Co.) 12,730. May 31st.

ELECTROLYTIC METERS FOR ELECTRICITY. E. Mier y Miura. 13,589. June 13th.

ELECTRIC METERS OF THE MOTOR TYPE. J. Wetter. (A. May.) 13,928. June 18th.

MEANS FOR APPLYING PRESSURE TO COMMUTATOR BRUSHES. Morgan Crucible Co. and J. E. Grant. 13,978. June 18th.

ELECTRIC METERS OF THE ELECTROLYTIC TYPE. E. Schattner. 15,060. July 2nd.

TERMINALS OF ELECTRICAL MACHINERY OR APPARATUS. J. T. Westwood and W. L. Jones. 16,314. July 19th.

ELECTRIC APPARATUS FOR THE IGNITION OF MINES. R. O. Berglund, W. A. W. E. Hjorth and C. E. Ljungman. 16,690. July 24th.

COMMUTATORS FOR ELECTRICAL GENERATORS OR MOTORS. Morgan Crucible Co. and C. W. Speirs. 23,305. October 20th.

FOUNDATIONS OR PEDESTALS FOR TROLLEY STANDARDS, TELEGRAPH POLES AND THE LIKE. G. Ritter. 23,772. October 25th.

METHOD OF MANUFACTURING CELLULOID BOXES OR CONTAINERS SUITABLE FOR SECONDARY ELECTRIC BATTERIES OR OTHER USES. M. Orban. 25,410. November 10th.

ELECTRIC RESISTANCES. R. von Brockdorff. 27,934. December 27th. (Date applied for under International Convention, December 8th, 1905.)

AUTOMATIC STARTER FOR CONTINUOUS-CURRENT ELECTRIC MOTORS. Fried. Krupp Akt.-Ges. 28,562. December 14th. (Date applied for under International Convention, March 22nd, 1906.)

REGULATION OF ELECTRIC FURNACES. C. Bingham. 28,593. December 14th.

TELEPHONE SWITCHBOARDS. H. H. Lake. (Stromberg-Carlson Telephone Manufacturing Co.) 10,554. May 5th.

TELEPHONE WALL BOXES. H. H. Lake. (Stromberg-Carlson Telephone Manufacturing Co.) 10,558. May 5th.

TELEPHONE EXCHANGE SYSTEMS. H. H. Lake. (Stromberg-Carlson Telephone Manufacturing Co.) 10,580. May 5th.

1907.

DYNAMO BRUSHES. J. Ringsdorf. 498. January 8th. (Date applied for under International Convention, January 11th, 1906.)

SPARKING PLUGS FOR INTERNAL COMBUSTION ENGINES. R. Bosch. 1,840. January 24th. (Date applied for under International Convention, February 24th, 1906.)

ELECTRICAL CONTACT DEVICE FOR THE IGNITION OF EXPLOSIVE CHARGES. F. Fink. 3,247. February 9th.

ELECTRO-MAGNETIC COMPASS. L. D. J. A. Dunoyer. 4,669. February 25th. (Date applied for under International Convention, March 5th, 1906.)

INSTRUMENTS FOR REGISTERING THE USE OF ELECTRIC CURRENT IN ELECTRICALLY-PROPELLED VEHICLES. Allgemeine Elektricitäts Ges. 6,527. March 18th. (Date applied for under International Convention, March 27th, 1906.)

ELECTRIC CANDLE LAMPS. R. Griffiths. 1,070. January 15th.

ELECTRIC SMELTING FURNACES. E. A. A. Gronwall, A. R. Lindblad and O. Stalhane. 1,658. January 22nd. (Date applied for under International Convention, January 26th, 1906.)

GUARDS OR CAGES WHICH ARE PARTICULARLY APPLICABLE FOR USE WITH INCANDESCENT ELECTRIC LAMPS. J. B. Brown, A. Brown and A. Gresty. 3,757. February 15th.

DYNAMO-ELECTRIC MACHINES. M. Latour. 3,904. February 16th. (Date applied for under International Convention, February 16th, 1906.)